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PUBLISHED BY THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY
PROFESSOR JAMES GEIKIE, LL.D., D.C.L., F.R.S., HON. EDITOR
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THE SCOTTISH

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MAGAZINE.

THE LAND OF PARROTS.

By Captain PASFIELD OLIVER.

PART I.

AN EARLY FRENCH VOYAGE TO MADAGASCAR EXAMINED.

(With two Maps.

IN response to a scheme suggested by M. Maupertuis[1] in the middle of the last century, M. le Président de Brosses, of the French Academy of Sciences, caused to be published at Paris, in 1756, two quarto volumes[2] containing a digest of all procurable information relating to voyages in the southern hemisphere. The object was to stimulate enterprise and discovery of habitable countries between Africa and America and to encourage the establishment of French colonies.

In the present notice it is only intended to examine the third article in the first of M. de Brosses' volumes, which deals with the narrative of one Binot Paulmyer de Gonneville and his alleged discovery in Australasia.

---

[1] Pierre Louis Moreau de Maupertuis, a famous geometrician and astronomer, born 1698, was one of the first to raise his voice in favour of Newton against Descartes, when he entered the Academy of Sciences in 1723. He measured a degree of the meridian under the Arctic circle in Sweden during 1736-37, and reorganised the Prussian Academy for Frederick II. at Berlin, where he was overwhelmed by the ridicule of Voltaire. He died at Basle. His *Lettre sur le progrès des Sciences*, 1752, mentions Gonneville.

[2] *Histoire des Navigations aux Terres Australes.* Contenant ce que l'on scait des moeurs et des productions des Contrées découvertes jusqu'à ce jour; et où il est traité de l'utilité d'y faire de plus amples découvertes, et des moyens d'y former un établyssement.

TOME PREMIER.—Nec usquam Deus abscidit
Terras Oceano dissociabili.—HORAT.

À PARIS.—Chez DURAND, rue du Foin, au Griffon, M.DCC.LVI. Avec Approbation et Privilége du Roy (pp. 102-120 inclusive).

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My attention was drawn to this narrative by a passage in the introduction of Captain Matthew Flinders' valuable record of his voyages,[1] wherein he identifies the land said to have been discovered as Madagascar. The gallant and unfortunate commander of H.M.S. *Investigator* writes thus:—

"Nor yet will much be said upon the plea advanced by the Abbé Prevost,[2] and after him by the President Debrosses, in favour of Paulmier de Gonneville, a French captain: for whom they claim the honour of having discovered Terra Australis in 1504. It is evident from the proofs they adduce, that it was not to any part of this country, but to Madagascar, that Gonneville was driven; and from whence he brought his prince Essomeric to Normandy."

It is proposed in the following pages to follow up this clue and to discuss the various indications which served to induce Captain Flinders' sagacious opinion, since generally considered to be erroneous. The article of De Brosses reads as follows:—

"Extract from a judicial declaration made by the Sieur de Gonneville at the office of the Admiralty, at the request of the Procureur du Roi on the 19th July 1505, and inserted in the *Memoirs concerning the establishment of Christian Missions in the Third World, or Terra Australis,* printed at Paris, by Cramoisy, 1663,[3] dedicated to Pope Alexander VII. by an ecclesiastic, an aboriginal native of Terra Australis.

"This ecclesiastic is not otherwise designated by himself than by the initial letters J.P.D.G. Indian priest, Canon of the Cathedral of S.P.D.L. It appears that the two first letters signify Jean or Jacques Paulmier, since his ancestors had taken the name of the family of Sieur de Gonneville.

"The said priest was born in France as well as his father and his grandfather, but his great-grandfather was one of the Australians whom Gonneville had brought back in his ship, and whom he married, in Normandy, to one of his relatives, after he had embraced the Christian religion. The great-grandson of this person, the author of these memoirs, animated by a great zeal for the establishment of the faith in his native land, spent all his life in inducing those engaged in foreign missions to send him back there and to influence the French Ministry to fulfil the promise given to his ancestors to return thither with another expedition.

"From the age of seventeen years he set to work, with the aid of certain manuscripts which remained with him and the traditions handed down in his family, to repair the loss of the journals of Gonneville, which, having fallen on his return into the hands of the English, had not since been recovered. He communicated his views to

[1] *A Voyage to Terra Australis*, 1801, 1802-1803. (London), 1814.

[2] *Histoire générale des Voyages, Tome XVI.* (*La Haye*), pp. 7-14.

[3] Pope Alexander VII., Fabio Chigi, born at Sienna 1599, assumed the tiara on the death of Innocent X., 1655. He died 1667. Not Gabriel Cramoisy, as M. D'Avezac states, but André Cramoisy, one of a famous family of printers, and the last: he was publisher and translator as well as printer, from 1655 to 1715.

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Louis Abély,[1] Bishop of Rodez, to Vincent de Paul, the Superior of the priests of the Mission, and to several other missionaries. We can conjecture from this at what date they were collated. Vincent de Paul[2] intended to present them to the Pope, but was prevented by death. They next came into the hands of M. Feret, Curé of St. Nicholas in Paris, and then reached M. Cramoisy, the bookseller, who published them. This detail has been necessary to establish the fidelity of the work, and the verity of an exceedingly old maritime expedition, which, without difficulty, assures to the French nation the honour of the first discovery of the Terra Australis,[3] sixteen years previous to the departure of Magellan. These memoirs, however crude, appear in fact most faithful, and carry on their face the visible signs of veracity.

"There are reasons, however, to suppose that he has slightly flattered his country in the favourable portrait which he has drawn of it. The greatest fault, however, of which he can be accused is that he has omitted to indicate the latitude and longitude, the geographical section being that in which he appears to have been least informed, on account of which it is absolutely impossible to determine now the real position of this country.

"It has been thought that it might possibly be on the same coast where our charts mark a cape called Terre de Vue or Cap des Terres Australes (long. 7° lat. 42°). Captain Bouvet,[4] at the time of his voyage in 1739, supposed that the country of Gonneville was somewhere under this meridian towards the 48th degree of latitude, but the narrative of the author helps but little in these conjectures. The country in question appears to be more to the east and less to the south. There is a great probability that it is to the south of the little Moluccas, in the part which I have named previously Australasia. MM. Duval[5] and Nolin, geographers of indifferent ability, without attending to what Gonneville says himself, that he found this country on the route to the Indies after he had doubled the Cape of Good Hope, have marked it in their charts to the south-west of this cape in about 48° lat. and 20° long. They name it Terre des Perroquets, I know not wherefore. Not content with this, they have, moreover, traced a long line of coast, which extends from thence almost close

[1] Louis Abély (*sic*) is best known as the responsible editor of the first life of Vincent de Paul, which had been compiled by the Lazarist priests of the Mission. His name is more properly spelled Abelly or Abelli, in which last form it appears in the *Biographie Universelle.*

[2] Vincent de Paul died in 1660.

[3] An abridged translation of M. de Brosses' volumes by John Callander was published by Donaldson at Edinburgh in 1766, in 3 vols., in 8vo, entitled, *Terra Australis Cognita; or, Voyages to the Terra Australis or Southern Hemisphere, during the Sixteenth, Seventeenth, and Eighteenth Centuries.* This has been compared with the original, but it has been thought preferable to give M. de Brosses' account complete and unabridged. The 20 quarto pages of De Brosses are reduced by Callander to within 10 octavo pages, pp. from 63-72. Book ii., Art. iii.

[4] Jean Baptiste Charles Bouvet de Lozier, born 1706, was sent by the French East Indian Company to discover Gonneville's Land in 1738. He was afterwards appointed Governor of the Isle Bourbon and Governor of the Isle of France in 1752.

[5] Pierre Duval, geographer royal, a nephew of Nicolas Sanson, cartographer, 1618-1683.

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up to New Holland, where Duval has placed the imaginary kingdoms of Psittac, Beak, Lucak, and Maletur.[1] Instead of having recourse to the Greek language to multiply these places, he might have contented himself by making one country of the kingdom of Psittac and of the Land of Parrots."

Thus, so far, writes De Brosses. We now give the introduction of the said extract from De Gonneville's journal by the ecclesiastic, Jacques Paulmier, as follows:—

"It could be wished that a better pen than mine were engaged to depict the features of the Southern regions of the world. But I must not, without betrayal of my trust, spare myself from performing my duty to the natives of Terra Australis, a duty which I owe to them by my birth and profession. The blood of my kindred race invites me, since a little while after the Portuguese had opened up the famous route to the East Indies, some French merchants, incited by the report of their rich commerce, fitted out a vessel which, whilst sailing thither, was cast by a hurricane on the shores of that great Southern land, *not far from the straight course to the East Indies.*

"The aborigines of these unknown countries received the Europeans with veneration and treated them for six months with extraordinary cordiality. They (the Europeans) being unwilling to return, without bringing with them some inhabitants of this new region, according to the usual practice of those who discovered new countries, practised with such ingenuity upon the credulous simplicity of their hosts, that they obtained from the chief of the nation one of his children, under the pretended promise of bringing him back instructed in the arts of Europe; especially in the secret of fire-arms and the means of subjugating their enemies, matters which the Southerners desired with an incredible passion.

"The Indian was then brought to France, where he lived long enough to have been seen by persons still living; and where he received, with baptism, the name and the surname of the captain who had brought him.

"This same captain, in recognition of the kind hospitality which the natives had shown him, and in order to acquit himself honourably of what he owed to a man whom he had transported by artifice from his country to a strange world, procured for him a small endowment and a marriage with one of his relatives. One of the children who sprang from this union is my paternal grandfather.

"The French have sworn to my compatriots to return to their country. The natural inclination which I feel towards it and the right that I have to represent here those from whom I take my origin, induces me to supplicate that the succour which they have been led to hope for will not long be refused to them. The priesthood with which I am

[1] In his map of the two hemispheres, "Utriusque Hemispherii Delineatio," Corneille Wytfliet locates these imaginary territories. See also the same author's map of the Australis Terra in his *Histoire Universale des Indes Orientales et Occidentales*, 1605.

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invested forces me to insist with all my might and opens my mouth to declare the story of this expedition as taken from the original memoirs of my family.

"The celebrated Vasco da Gama having shown the way to the East Indies, Lisbon was, in a short time, filled with the riches of the East, of which the fame struck the eyes of certain French merchants trading at the port of that city. They formed the design of following in the tracks of the Portuguese and to despatch a ship to these famed Indies.

"The vessel was fitted out at Honfleur, at the mouth of the Seine. The Sieur de Gonneville, who was its commandant, weighed anchor in the month of June 1503[1] and doubled the Cape of Good Hope, where he encountered a terrible storm, which caused him to lose the course and left him to the wearisome calm of an unknown sea. Not knowing then which way to steer, the sight of some birds flying from the south determined his course in the hope of finding land where they could refit and find water. Here they met with what they desired, viz., a great country which is called in their report the South Indies, according to the custom of the time, when the name of the Indies was applied to all newly discovered countries. They anchored in a river which they compared to the Orne which flows under the walls of Caen. Their stay lasted about six months, which they employed in rebuilding their vessel damaged by the tempest; after which the refusal of the crews to go any farther, on account of the unseaworthiness and disrepair of the ship, obliged Gonneville to return to France.

"[2] During this long stay of six months he had leisure to note the features of the country and the characteristics of the inhabitants, of whom he has given many interesting details in his journal; but he was so unfortunate as to fall, when in sight of the French coasts near the islands of Jersey and Guernsey, into the hands of an English corsair, who deprived him of all that he had.

"Gonneville, on reaching land, laid his complaint at the Court of Admiralty, and, at the request of the Procureur du Roi, accompanied it with a succinct account of his discoveries. This declaration, a duly authenticated document dated 19th July 1505, is signed by the

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[1] The *Nouveau Collecteur des Voyages* gives this date, in error, as 1603 in the Chronological list. Tit. xi. p. 201.

[2] "It is noticeable that the author only commences his extract from the judicial declaration of Gonneville at the paragraph which describes the people of the country. Doubtless Gonneville had commenced by making mention of his arrival and of the position of the coast where he landed, which would be most important to ascertain at the present day. M. Count de Maurepas, Minister of Marine, had caused a search to be made in the archives of the Admiralty offices in Normandy, to find, if possible, the original of this declaration: but all the ancient depositions (*procès-verbaux*) in these registries have disappeared. The civil wars, an interval of two centuries and a half, and the want of order in which these papers were kept, account for their loss. The only information obtainable by M. de Maurepas was to the effect that there had always been a tradition that such a document existed in the Admiralty, but that no one knew at the present day what had become of it. I [M. de Brosses] learned this fact from Count de Caylus, who himself gave directions for the search for the declaration of Gonneville."

[It will be seen, in Part II., that what purports to be a copy of this document has since been discovered, and that it considerably upsets some of M. de Brosses' conjectures and theories.]

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principal officers of the ship. I here transcribe some extracts from it in the very words used in the original, being sure that the unpolished naïveté of the style cannot prove unwelcome.

"They (the subscribers to the document) say that during their residence in the said land they conversed freely with its people, after they had become sociable with the Christians by kindness and small presents made to them. These same Indians being simple folk, only caring to lead a happy life without much labour, living by hunting and fishing and by what the earth afforded spontaneously, as well as by various vegetables and roots which they planted; going half-naked, the young and common people especially. They wear robes either of woven mats, skins or feathers, like those of the Egyptians and Bohemians (gipsies) in our own country, only perhaps shorter, with sorts of kilts girded about their hips, reaching to the knees of the men, and to the calves of the legs with women; for the men and the women are clothed in the same manner, except that the clothes of the women are longer and they wear necklaces of bone and shell; not the men, who instead carry bows and arrows, with points either of sharpened bone or of a species of very hard wood, burnt and sharpened at the end, which is all their equipment.

"The women and girls go with bare heads, having their hair neatly plaited with little twists of fibres of bright and glistening colours. As for the men, they wear long hair hanging down, with a head-dress of high plumes richly coloured and well arranged.

"They state further that they penetrated into the country for a good two days' journey and along the coasts besides, both to the right and to the left, and found the land to be fertile, provided with much cattle, birds, and fish and other remarkable things unknown in Christendom, and of which the late M. Nicole le Febvre of Honfleur, who was a volunteer in the voyage, and a gentleman of skill and science, had made drawings, which, however, were lost with the journals of the voyage when the ship was pirated, which loss is the cause which renders this account imperfect and many fine discoveries omitted.

"It is stated that the said country is populous here and there, the dwellings of the Indians are in hamlets of thirty, forty, fifty, or eighty huts, arranged like a market place, made of stakes driven into the ground, close to one another, interlaced with grass and leaves, with which also these huts are thatched, and for a chimney there is a hole to let the smoke out: the doors are of canes neatly interwoven, and they shut them with wooden latches like those of country stables in Normandy, and their beds are of soft matting filled with leaves or feathers, their clothes of mats, skins, or feathers, and their household utensils of wood, as also their cooking pots; but these are protected by a sort of clay, about an inch thick, which prevents the fire from burning them.

"They remarked that the country is divided into small cantons, each of which had its king; and although these kings are neither better housed and dressed than the others, nevertheless they are much revered by their subjects, and no one is so bold as to dare refusing or obeying them, having the power of life and death over their subjects, of which some of the crew saw a memorable example, viz., of a young lad of from eighteen to twenty years who in the heat of passion had struck his mother; having learnt of which, although the mother made no complaint, the chief sent in search for him and caused him to be thrown into the river with a stone at his neck, after he had assembled, by public notice, the young men of the village and other neighbouring places, and no one could obtain remission, not even the mother herself, who went on her knees to beg the pardon of her child.

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"The king was the chief in the land where the crews stayed, and had the name Arosca; his country extended about one day's journey, and comprised about a dozen villages, each of which had its own chief, who all obeyed the said Arosca. This Arosca appeared to be sixty years old, a widower with six sons between thirty and fifteen years, and both he and they often came to the ship—a man of grave demeanour, middle stature, stout and benevolent aspect, in peace with the neighbouring kings; but he and they were at war with the people who were inland, against whom he twice fought whilst the ship stayed there, taking from five to six hundred men each time, and at the last occasion, on his return great rejoicing was exhibited by all his people for having won a great victory. Their so-called wars were nothing more than raids of a few days' duration on the enemy, and they were most desirous that some of the crew should accompany them with fire-arms (*bastons à feu*) and artillery to frighten and put to rout their enemies, but they excused themselves.

"They say that they did not remark any peculiar mark which distinguished the king from the other kings of the country, of whom at least five came to see the ship, except that the kings wore plumes on their head of one single colour, and voluntarily their vassals, at least the principal ones, also wore, in their headdress of plumes, some tufts of feathers of the same colour as their chiefs, which was green for Arosca their host.

"They say that had the Christians been angels descended from heaven they could not have been better treated by these poor Indians, who were altogether amazed at the size of the ship, the artillery, the mirrors and other things which they saw in her; and above all that, by means of a letter despatched from on board to some of the crew who might be in the villages, they could ascertain what was wanted, nor could they understand how the paper could speak, and on this account they greatly feared the Christians.[1]

"Yet for the sake of several little gifts made to them of ornaments, knives, hatchets, mirrors, glass beads and such baubles, the Christians were so beloved that for them they would do anything in the world, bringing them plenty of flesh and fish, fruit and victuals and whatever they saw would be pleasing to the Christians, as skins, feathers, and dye-roots; in exchange for which were given to them ironmongery and other articles of little value, so that nearly an hundred quintals of such commodities were collected, which in France would have realised a large sum.

"They say that wishing to leave tokens in the country that it had been the abode of Christians, a large wooden cross was made thirty-five feet in height, and well painted, which was planted on a rising ground in view of the sea with great and devout ceremony to the sound of drum and trumpets on a day expressly chosen, viz., the Easter day of one thousand five hundred and four; and the cross was carried by the captain and principal officers of the ship, bare-footed, and assisted by the chief Arosca and his children and other Indian notables, invited to honour the occasion and seemingly joyful, while the crew followed under arms,

1 "Rer Moume perceived that my countenance chang'd whilst I was reading the Letter; and ask'd me, What was the Matter? I told him, That the captain desir'd to speak with me. . . . How do you know all this? says the Prince; Can you conjure? . . . Rer Moume took the letter, and turning it over and over, said, He had heard of such Methods of conveying Intelligence to one another, but never actually saw it before; and could not conceive which Way it could be done without Conjuration. I endeavour'd to demonstrate to him as well as I could, how we learn'd in our Infancy the characters first, and then we put them together."—(*Madagascar; or Robert Drury's Journal.* Edition of 1729, p. 425. Do., "Adventure Series." Unwin, 1890, p. 291.)

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chanting the litany, and a large crowd of Indians of all ages, whom for some time previous they had entertained, quiet and most attentive to the mystery. The cross having been erected, several discharges of musketry and artillery were fired. Feasting and handsome gifts to the chief Arosca and leading Indians, and for the populace plenty of largesse in the shape of baubles of little value, but prized by them, all that could be done to impress their memory. They were given to understand by signs and otherwise, by whatever means available, that they were to preserve and hold in honour the cross, and on one side of it were engraved the names of our holy father, the Pope of Rome,[1] of our king, of the Admiral of France, of the Captain, of the owners and members of the crew from the highest to the lowest, and for performing this work the carpenter of the ship received a present from each of the sailors.

"On the other side was engraved a distich in Latin, composed by Master Nicole le Febvre, who, in a pretty manner, set forth the date of the year of the erection of the Cross and who had set it up and placed it there :—[2]

HIC sacra pa L MarIUs, pos UIt gonIVILLa bInot Us,
Grex, soCIUs, parIterqUe progenIes.

(*Binot Paulmier Gonneville & toute la troupe qui l'accompagne, tant de la race d'Europe, que de celle des Indes ont ici posé ce monument sacré.*)

"Binot Paulmier Gonneville placed here (these) sacred (emblems).

"The numeral letters of this Latin distich together form the number 1504.

"They say further that, at last, the ship having been refitted (*gallifrestée*?) and victualled, as well as could be done, for the return was delayed in its departure for France, and as it was the custom with those who arrived at new countries in the Indies, to bring back to Christendom some Indians, by fair pretext, the Chief Arosca was induced to permit one of his young sons who had been on good terms with the crew to go to Christendom, and it was promised to the father and son, to bring him back within twenty moons at the latest (for thus they were given to understand months) and, what gave them more pleasure, they were made to believe that they would teach those who came artillery, which they desired greatly to overcome their enemies, and to construct mirrors, knives, axes and all that they saw and admired among the Christians. Such was their promise, as to a Christian might be promised gold, silver, jewels or the knowledge of the philosopher's stone. The which offers firmly believed in by Arosca, he was glad enough that they should take away his young son who had the name Essomericq, and gave him as a companion an Indian from thirty-five to forty years, named Namoa, and he himself and his people accompanied them to the ship, bringing provisions and beautiful feathers and other rarities, as presents on his part to our King : and the Chief Arosca and his people awaited the departure of the ship, making the Captain swear to return within twenty moons, and when the ship set

[1] Pope Julius II. (Giulio della Rovere), 1503-1513.

[2] Compare this with Don Manuel de Faria's account of King Bruto Chembanga of Fansaria (that is, Fanshere) on east coast of Madagascar, in 1613. *Vide infra.*

"The Portuguese set all hands to work to build a house and chapel for the two Jesuits and four Portuguese who were to remain, and when the work was finished, mass was solemnly said on shore, many of the natives coming to learn how to make the sign of the cross. One day while the king was looking on and saw several men labouring hard to carry a cross that was meant to be erected on a rock, he went half naked and bareheaded, and carried it without assistance to the place appointed."—(Kerr's *Voyages*, vol. vii. p. 7.)

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sail all the people made a great cry and gave them to understand that they would preserve well the cross, making the sign of it also by crossing two fingers.

"They say that they departed from these southern Indies on the 3rd day of July 1504, and saw no land until the morrow of St. Denis, having encountered diverse fortune and been severely distressed by a malignant fever, with which the sailors of the ship were attacked, and four of them died, to wit, Jean Bicherel of Pont'-l'évêque, surgeon of the ship, Jean Renoult, soldier of Honfleur, Stenoz Vennier of Gonneville sur Honfleur, (varlet) of the captain and the Indian, Namoa. It was debated whether he should be baptized to escape the perdition of his soul, but the said Master Nicole said this would be a profanation of the Saint Baptism in vain, for Namoa knew not the creed of our mother Church, as those who receive baptism on reaching riper years ought to do. And this Master Nicole was trusted as being the best scholar in the ship; and nevertheless although with some scruple, on the other young Indian Essomericq falling ill, and in peril, he was, by his advice, baptized, and he administered the Sacrament to him, and his godfathers were Captain de Gonneville and Antoine Thierry and in place of the godmother Andrien de la Mare was taken as a third sponsor, and he was named Binot, the baptismal name of the Captain. It was the 14th September that this was done, and it seems that the said baptism served as medicine both to the soul and body, for straightway the Indian got better, recovered and is now in France," etc. . . .

"Such" (writes Jean Paulmier de Gonneville, the Indian priest) "is the portion we learn of the declaration of Gonneville, with regard to which we can remark two things. The first that the southern countries are inhabited by people intelligent and capable of instruction; the other that the French have an especial interest in returning thither, as much for the honour of keeping the oath which was made, as well as to sustain in the eyes of other nations the advantage which they have had to have landed on the Terrae Australes before any of the other nations of Europe.

"Fortune has hitherto given the principal glory to Magellan,[1] who discovered something of it a little time afterwards, at the expense of Charles v.,[2] a prince endowed with brilliant genius and born for grand enterprises. Can it be wondered at, therefore, if an obscure and fortuitous voyage, by a private individual, has remained overshadowed by the *éclat* of an important expedition performed at the expense of a great sovereign, followed with a constancy which has crowned it with success, celebrated by so many pens, published by so many mouths?

"Their noise has easily stifled the voice of a simple individual declaring the little advantage which chance had offered against his hope, and that the French nation, which could gain as much profit as glory, has managed so badly that the memory of it only survives in the dust of a record office of an Admiralty Court. I will not refrain from declaring that it is necessary for the honour of France to keep faith with our sovereign Arosca, who received the French so cordially. This old debt must be paid and at the same time paid with interest for the delay. Can it be needed to press so long on a project so advantageous in itself? Can

[1] Fernand Magellan (Magalhaens) passed through the straits bearing his name in 1521.
[2] Charles v., Emperor of Spain, born 1500, died 1558.

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it be that the interest which I take in the cause of a people, for whom my blood inspires me with some affection, obliges me to seek some one who will speak to France in favour of so many millions of men? Hear what a Frenchman has to say on this subject, who from the year 1582 has exhorted the nation to cast their eyes on these southern lands:—

'"I only ask every one" (writes La Popelinière in his history of the world),[1] "to animate the courage too dormant in France to attempt some voyage afar after the example of their neighbours, for the honour, at least, of the nation by some noble exploits. There yet remain countries to discover not hitherto known to modern explorers, which cannot be less rich in treasures, rarities, and miracles of nature, if we have the address to go to seek them towards the south where no other nation has reached. The Portuguese have sailed to the east and the Spaniards to the west, Germans and English to the north. No one has made any attempt to the southern regions which are so great and consequently subject to all sorts of temperatures, as well as the rich America. They cannot be less provided with riches and singular objects than the other parts of the universe, witness their width and large extent which causes us to term them the unknown world. It is there where the princes of these days should demonstrate their enterprise in things beautiful and profitable, by the exploration of this third world. It is to deny nature herself and the duty of humanity not to labour to obtain honour and profit from an undertaking so advantageous to the whole age in which we live; for (if we can judge of the resemblance by the truth, and the things unknown by those which do exist) witness the situation and extent of that third world, it is impossible that there must not be things wonderful in delight, richness and other commodities of the human life. When he can find nothing worthy of memory, research will ever be praiseworthy in a prince who will explore it. It is very well to say that we no longer have those incentives of virtue which led the ancients to undertake such lofty enterprises, which the more difficult they found the greater trouble they took in their pursuit. We work so hard to gain a battle, to take a town, to conquer a small country, in short, to procure an advantage which we find of but brief duration and ill assured. Here is a world filled with all sorts of good and excellent things. It has only to be discovered. We have only to follow the example of other nations who have opened out so fine a road. Renown promises to the Captain who is destined to make its discovery an illustrious rank with Columbus, Vespucius, Magellan, Cortez, and Drake."'—Lanc. Voisin de la Popelinière, *Histoire de Trois Mondes*, liv. 3.

President de Brosses next proceeds to give some

New Elucidations on the Author of the Memoirs above quoted.

"I draw these notes" (writes M. de Brosses) "from a copy of the memoirs which I have just found in the library of M. Falconet,[2] of the Royal Academy of Inscriptions and Literature. Although this copy may be of the same edition as that of which I have made use, we do not find

[1] Lancelot Voisin, sieur de la Popelinière, the historian, born in 1540, published, in 1582 *Les Trois Mondes*, giving a description of the three divisions of the world, including a notice of the Terrae Australes, till then but little heard of. He died in 1608.

[2] Camille Falconet, a literary savant of Lyons, whose library was the resort of many celebrated writers. He died in 1762. The catalogue of his library by Barrois is still extant.

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there a notice in which the author, under the name of a third person, complains that the bookseller, Cramoisy, had printed these memoirs in 1663, without his knowledge, declaring that he had for a long time delayed the publication to which he had only, in fact, consented reluctantly.

"On the other hand, the dedicatory epistle to the Pope Alexander VII. is signed at full length, 'Paulmier prêtre indien,[1] chanoine de l'église cathèdrale de Lisieux.' This copy had been given by the author himself to M. de Villermon, who has written opposite the following note:—

'M. Abbé Paulmier, Canon of Lisieux, Resident of the King of Denmark in France, presented me in 1664 with this book, of which he is the author. He has great erudition and considerable knowledge of foreign affairs; he has travelled over nearly all Europe, being employed on a mission, as in Poland[2] for the late Vincent de Paul. He died at Cologne during the Congress of the plenipotentiaries of peace.

'He told me two curious things. The first is a suit which was preferred against him by the partisans who have instituted a tax on foreigners, which they tried to make him pay, as being the issue of a savage of Terra Australis, against which he pleaded so effectually in his own person that he was absolved from the tax, having argued among other reasons that he, from whom he was descended on the female side,[3] had only come to France on the ship of Captain Gonneville on the promise which the Captain had made to his father, who was a minor king of the country from whence he had been brought, to carry him back within a certain time; which promise not having been executed, he was within his rights in complaining of the bad faith which had been used towards him, and which exposed him to the persecution of partisans.

'He also told me that the Captain Gonneville who had brought into France his ancestor, seeing that those with whom he had been associated in his voyages, and who were nearly all his relatives and heirs, were unwilling to contribute new funds towards the equipment of a ship designed to return to the same place, and to acquit himself of his word to the father as well as towards the son, had made the last his residuary legatee, by a principle of equity, to prevent his falling into poverty in this country, not being able to take him back to his own, where he needed for nothing. The goods left him by Captain Gonneville enabled him to marry well with an heiress from whom M. Paulmier is descended on the female side. The captain obliged him by his will, both him and his male descendants, to assume his name and arms.

'It was at the houses of MM. the bishops of Heliopolis[4] and Berytus that I first saw M. the Abbé Paulmier, where we met commonly with the late M. de Flacourt, who had commanded in Madagascar, and M. Fermanel, the father of the Superior of the foreign seminary.

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[1] It will be seen, in Part II., that "*prêtre indien*," is, in reality, to be read "*prêtre indigne*."

[2] Vincent de Paul sent out a mission to Poland, at the request of Marie Louise de Gonzagna, in 1651. Lisieux in Calvados, Normandy.

[3] "This is" (subjoins M. de Brosses) "an error of the memo. of Sieur Villermon. Paulmier was the issue of the savage by the *male* side. Apart from the fact that the suit brought against him and the name which he bore form evident proofs of it, he himself states that the savage was his paternal great-grandfather."

[4] The Abbé Palus was Bishop of Heliopolis *in partibus infidelium*; and the Abbé Lambert, Bishop of Berytus.

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'There the Abbé Paulmier did his utmost (this was in 1653) to persuade them that nothing was more worthy of their zeal than an establishment in the Terra Australis, and he brought us two manuscript copies of these memoirs that each of us might examine them and express his opinion of them. They contained many other things which are not printed here. I have known few persons better instructed in proper navigation than him and in voyages of which he has made a deep study. He has not less knowledge of literature and history, especially of sacred history, and of all that concerns his profession, as theology and the canonical laws,' etc.

Following the above, M. Falconet[1] has added this note :—

"At the end of the second volume of the voyages of Coréal (Paris 1722, p. 390)[1] is the history of Binot Paulmier, called Captain Gonneville, gentleman of Normandy, of the house of Buschot, who departed from Honfleur in 1503, and brought from the Terra Australis Essomérik, one of the sons of king Arosca, whom he caused to be baptized, giving him his name and his surname. This Essomérik lived until nearly 1583 [there has possibly been a fault in this date, De Brosses] and left posterity under the name of Binot. One of his grandsons, J. B. Binot, President of Treasurers of France, in Provence, left only one daughter who married the Marquis of la Barbent." See le P. Anselme, *Histoire généalogique*, Tom. viii. page 300, where occurs the following :—"Jacques de Forbin, Lord of la Barbent, married 4th May 1725 to Charlotte Paulmier, daughter of Jean Baptiste (I believe it should be Jean Binot) Paulmier, President of Treasurers general of France, in Provence, and of the Marquise d'Andrea and leaves issue."

The existence, well authenticated, of this family, come from Terra Australis and brought to France by Captain Gonneville, is a proof without reply of the truth of the voyage of this Captain, on which some persons yet entertain doubts."

So far the account by the learned and serious President of the Burgundian Parliament[2] in the year 1756. Now let us compare the story with that told by Robert Drury in 1728, which has a curious bearing on the foregoing relation, from several points of view.

It has been pointed out in the pages of the *Antananarivo Annual*[3] that there is reason to suppose that [Daniel Defoe?], the editor of Robert Drury's journal, had access to French works and notably to Flacourt's *Histoire de la Grande Isle de Madagascar*. The editors of that *Annual* are, as is well known to their readers, in favour of the substantial veracity of Drury's relation. A certain amount of examination seems to show a remarkable coincidence between one of Drury's historical and traditional anecdotes [at least so it is alleged by his editor], actually heard by him and accurately remembered after several years' interval, "*exactly as the people themselves told*" him and the account published by the so-called "Indian" priest in Paris, in 1663, just forty years before Drury was wrecked in Madagascar when a boy of fifteen years of age.

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[1] "*Vide ante*, p. 10, M. Falconet of the Academy in whose library above-mentioned memoir was found."

[2] This extract is not to be found in the edition of Holland of 1722, which I have consulted (M. de Brosses). Charles de Brosses, First President of the Parliament of Burgundy, born 1709, died 1777.

[3] Vide *The Antananarivo Annual*, 1865, pp. 17-26. "Robert Drury's Madagascar. Is it a fiction?"

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Drury's editor, a writer of undoubted literary ability indeed, seems to have a dim idea that some such story had been heard before, and therefore Drury prefaces his following history with a few remarks to forestall any such rude criticisms which might possibly suggest that he was retelling an ancient tale,[1] or cribbing it from a recent French historian. Here it is!

King Samuel's History.

"King Samuel's History being very singular, I shall here relate it as I learn'd it at Times from the Natives. Whether any of the French Authors of Voyages have wrote any Thing of him I know not; nor have I had the Opportunity of seeing their Histories of Madagascar to compare with this of mine. It is exactly as the people themselves told me, and I shall not alter, or vary from their Account of it, whether it is agreeable to what others have said or no.

"This Part of the Country, to which the French have given the Name of Port-Dauphine, is called in the Madagascar Language, Antenosa. About ninety years ago, there came hither two French Ships; on what Account, Voyage or Business they were I can't learn; but they came to an Anchor close under the Land in a very good Harbour. The Captains observing that there were Plenty of Cattle and all Provisions, as also a very good Soil, concluded that one of them should stay here and make a Settlement; hereupon they cast Lots who should remain on the Island, and he on whom the Lot fell was Captain Mesmerrico. [I must here desire my Reader to take Notice, that this is the Name the Natives told me, who, very likely, being unlearned, may pronounce it very different from the true Name; but besides, as it is also some Time since, and they have no Writings or Records of Things, so consequently, they can have no History, but by Tradition, as the Father tells the Son, and so on to succeeding Generations.] This Captain Mesmerrico landed with two hundred white Men, well arm'd with Store of Ammunition and other Necessaries proper for the building of a Fort which they immediately began. The Natives no sooner observed their Intention, but they endeavour'd to hinder them; this caus'd a War, in which the French were the Conquerors, who took at several Times many Prisoners: In this War, the King of Antenosa and his Brother were kill'd; and amongst many other Children which were taken, the King's Son was one. When the French had suppress'd the Natives, and built their Fort, the Ships sail'd away to France, and carry'd this young Prince and many other Captives with them."

. . . . . .

Now this story reads remarkably like the romantic episode said to have occurred in 1503 by the Abbé Paulmier de Gonneville. The question at once arises where did Drury's editor obtain his mutilated version of the tale, for it is almost self-evident that Drury could himself hardly have obtained the facts from the Natives themselves; yet, he expressly denies having learned it from any of the French authors.

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[1] See *Robert Drury's Journal*, p. 106.

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Now we find the following history in Flacourt's narrative; but first, I would observe that, on reading M. de Brosses' account given above, I was interested by noticing that M. de Villermon states that he met the Abbé in company with M. de Flacourt at the houses of the Missionary Bishops of Heliopolis and Berytus; for if the country described by M. Paulmier had been Madagascar, surely M. de Flacourt would have recognised the coincidence and similarity; but strange to say M. de Flacourt seems not to have recognised the curious parallelism of the French visit to Arosca with the Portuguese adventures at Anossi in Madagascar. The identity of the original source of the information obtained by Drury's editor is obvious.

The Story as related by the Sieur de Flacourt.[1]

"The French," writes de Flacourt (in 1658), "can boast that no Christian ship has discovered Terra Australis before the French vessel, which left, in 1503, Honfleur, a seaport town in the Bailiewick of Rouen, and of the Diocese of Lisieux in Normandy, under the command of Binot Paulmyer, called the Captain de Gonneville, of the family of the Seigneurs of the Buschet fief and the seigneuries in the parish of Gonneville lez Honfleur.

"This gentleman and some other adventurers put to sea with the design of sailing to the East Indies, to which the Portuguese, by doubling the Cape of Good Hope, had opened the way, some five or six years previously. But having been surprised by a long and boisterous tempest, being about the latitude of this cape [observe how careful Flacourt was to follow the old deposition; he does not say doubled the Cape] which had been formerly named rightly the Cape of Storms [le Cap tourmenteux], and having lost their track, they found themselves cast on the coasts of the Terrae Australes, which their journal, deposited at the office of the Admiralty, following the ancient custom, calls the Southern Indies [les Indes Méridionales] on account of their situation.

"They sojourned in this country nearly six months, as much to repair their vessel as to freight it for the return, which was determined upon partly by the bad state of their ship, and partly by the refusal made by the crew to proceed farther. Their account says nothing against the temperature of the country, praises its fertility, and describes its inhabitants as people endowed with the simplicity of the golden age, reasonable, inquiring, and who received the French with admiration, respect, and love. Our Frenchmen spoke well of the good reception they met with on the part of these Indians, and among others from their king, Arosca, who ruled over the country for the space of two or three days' journey in the neighbourhood of the localities where the ship of Captain de Gonneville had cast anchor.

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[1] *Relation de l'Isle Madagascar*, pp. 465, 466.

This notice of Gonneville's voyage has been reproduced, in an abridged form, in an appendix to the *Voyages de François Coréal aux Indes Occidentales.* Nouvelle édition, revue, corigée et augmentée d'une nouvelle Découverte des Indes méridionales et des Terres Australes. Paris, 1722, 2 vols. in 12; tome ii. pp. 390-392; with maps by Nolin.

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"This Captain, moved by the usual desire common to the discoverers of new lands, availed himself of the natural curiosity of the Indians and of the influence he had gained over their spirits, so far, that he obtained from this petty king one of his children, named Essomeric, to come with him to Europe, under promise to bring him back, at the latest, within twenty moons (it is thus they counted the months) and to bring him back instructed in the invention of our artillery and of an hundred other things which they admired of ours and which they eagerly desired.

"Essomeric was carried off and not taken back; he was baptized and received the name of this Captain, who was his godfather, and subsequently conferred on him his surname, together with certain advantages, by which the Captain hoped to repair the wrong which he had done in evading his oath which he had sworn to take him back to his country. He arranged for him a marriage with one of his relations, and dying without children, he left divers testamentary legacies in favour of this Indian, who lived until 1583, leaving many children, of whom no male posterity remains, except one of the youngest, who bore also the name of Binot, the Sieur de Courthonne, who left a number of male children. Of whom two only married, one of the name of Jean Baptiste, President of the Treasurers of France, in Provence, who left only one daughter, wife of the Marquis of Barben, of the house of Fourbin in Provence; the other, Olivier, Sieur de Courthonne, who left Jean Gabriel and Robert Paulmyer, brothers; these two are still living at an advanced age, and the eldest is an Ecclesiastic and Canon in the Cathedral Church of Lisieux."[1]

Now it is, I consider, just possible that the Abbé Paulmyer, evidently an enthusiast and a devoted missioner, may have, somehow or other in 1661, confused the tradition of his great-grandfather's alleged arrival in France in 1503 with the conversion of the Malagasy prince by the Portuguese in 1613-17, according to De Flacourt.

The following accounts are given by De Flacourt, and Don Manuel de Faria.[2]

FLACOURT (p. 33).

"[3] Soixante ans après vint un Navire de Mozambique, qui enleua le fils de Dian Tsiamban, nommé Dian Ramach, & le mena à Goa: où ayant esté instruit par les Jesuites, baptisé par eux & tenu sur les fonds par le Vice-Roy, fut nommé Don Andre de Susa de Sahauedra.

"Trois ans apres fut amené à son Père par deux Pères Jesuites, qui demeurerent en la maison de Pierre auec six autres Portugais, ou Espagnols; mais Dian Ramach estant avec son pere, prist aussi-tost la pagne: & quitta la Religion Chrestienne, & a vescu ainsi jusques à la mort, qui luy est arriuée, à cause de sa perfidie, ayant voulu massacrer les François sans aucun sujet. . . ."

[1] It will be remembered that the Abbé's book was published in 1663, *after* Flacourt's death in May 1660. (He was blown up in a fight with pirates, 30th May.)

[2] See *Kerr's Voyages*, vol. vii. pp. 7, 8. De Faria relates how the king subsequently attacked the Portuguese, who repulsed them, but abandoned the mission.

[3] 1613.

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FLACOURT. (Chapitre xvi. p. 46.)

". . . Il s'appelloit Andian Ramach, duquel i'ay parlé cy-dessus, & apres sa mort Andian Maroariue.[1] Il a esté Chrestien & baptisé à Goa, nourry chez les pères Jesuites, & entretenu par le Vice-Roy de Goa, puis ramené en son pays & remis entre les mains de son père, qui appellait Andian Tsiamban. Il scauoit toute sa croyance, scauoit les prières Chrestiennes, escrire & lire en caracteres de l'Europe, non en Arabe, parloit bon Portugais, & rendoit raison de la croyance des Chrestiens. Mais si tost qu'il fut auec son pere il quitta la profession du Christianisme & embrassa plus qu'aucun les coustumes & superstitions du pais. Il fut tué par les François lors qu'ils furent attaquer le Village de Fans-here, où estoit sa demeure, & frappé d'un coup de fuzil entre les espaules; lors qu'il s'enfuit laschement & un sien fils aussi nommé Dian Tsanzoa; apres auoir fait auparauant plusieurs menaces & s'estre fiez par trop aux Ombiasses, & à leurs carractères ridicules, sorts, & charmes, desquels nous nous sommes tousiours mocquez."

MANUEL DE FARIA.

"King Chembanga requested that a Portuguese might be sent along with him to his residence, and left his nephew as an hostage for his safe return. Accordingly the master, Antonio Gonzales, and one of the priests named Pedro Freyre, were sent, who at twelve leagues' distance came to his residence called Fansaria,[2] a very populous and magnificent place. At first he treated them with much kindness, after which he grew colder towards them, but on making him a considerable present he became friendly, and even delivered to them his eldest son to be carried to Goa, desiring that the two Jesuits and four other Portuguese might be left as hostages, to whom he offered the island of Santa Cruz to live in. . . .

"De Costa demanded that the king's son, who had been promised, should be sent, but he denied having ever made any such promise, . . . and a party of Portuguese soldiers was sent armed against the King, who endeavoured to resist, and the King's son, a youth of eleven years of age, was brought away, the natives being unable to contend against fire-arms.

"Several messages were sent offering a high ransom for the boy; but, on being told by the captain that he would lose his head if he did not carry him to the Viceroy, they went away much grieved. This happened about the end of 1613, and towards the end of 1614 De Costa arrived safe at Goa with the boy, whom the Viceroy caused to be instructed in Christianity by the Jesuits, and stood godfather at his baptism on St. Andrew's day, when he was named Andrew Azeveda. The Viceroy treated him with much honour and magnificence, in hopes that, when he succeeded to his father, he might encourage the propagation of the gospel in Madagascar; and when he was supposed to be

[1] This seems to be the first notice of the change of name after death and the termination "arrivo" being added. The Malagasy apotheosis!

[2] Fanshere, now Fanjahira, north-west of Fort Dauphin.

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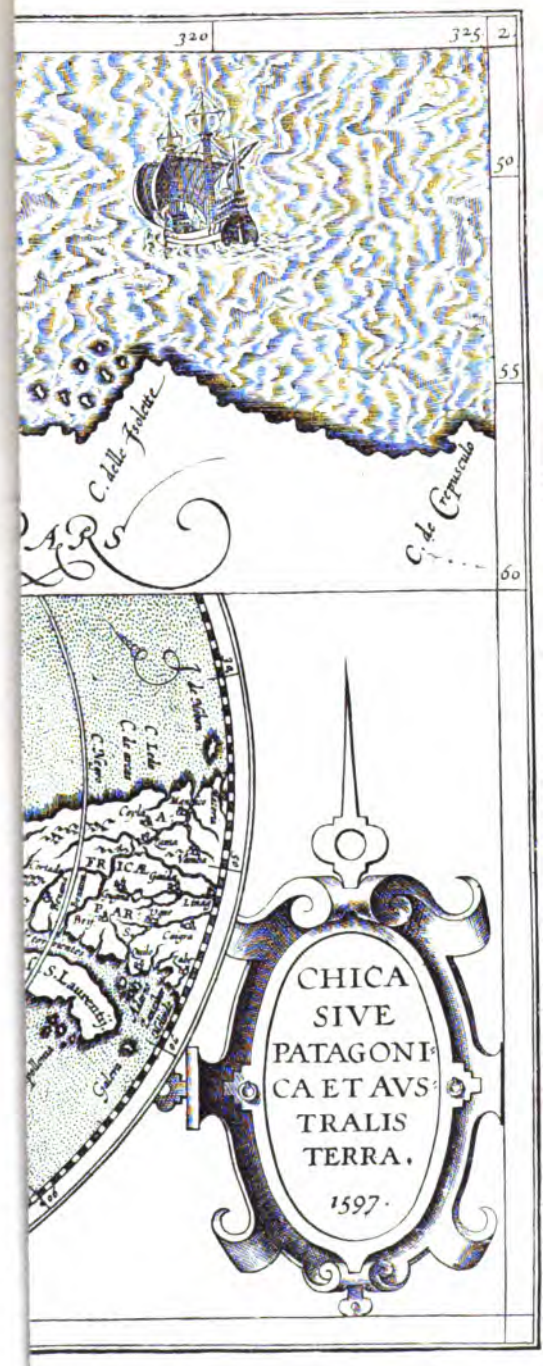

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sufficiently instructed he was sent away, accompanied by four Jesuits. On this occasion a pink[1] and a caravel[2] were sent to Madagascar, commanded by Pedro de Almeyda Cabral, and Juan Cardoso de Pina, who sailed from Goa on the 17th of September 1616. . . . On the arrival of the two Portuguese ships in the port of S^ta^ Lucia,[3] in Madagascar, the King and Queen of Matacassi received back their son with the strongest demonstrations of joy, and gave back the hostages left on taking him away. . . ."

In Part II. I propose to consider the opinions of later geographers and navigators respecting the so-called Terre des Papagaux towards the Antarctic regions. We may in conclusion quote the quaint sonnet of Sieur François Fabri, a contemporary of Cabral:—

"Si tu veux voir quels peuples Antipodes
Habitent l'Inde, habitent le Peru,
Et tous les lieux sous ce pole incognu,
Sans qu'à courir les mers tu t'incommodes:
Il n'est besoin qu'au gré des vents tu rodes
L'onde où Pilote est Colombe venu;
Cy tout se voit escrit par le menu,
Leur teint, leurs moeurs, leurs habits, & leurs modes.
Cy sont depeints leurs riuages, leurs bois,
Fleuves & monts, leurs villes & leurs loix,
Leurs corcelets, leurs arcs & leurs sagettes;
Et cy se voit leur aveugle fureur,
Auant qu'on ayt les tirez de l'erreur
Qui si loing temps tint leurs ames suiettes."

THE NEW SIBERIA.

By J. Y. Simpson, M.A.

(*Read at Glasgow and Dundee, December* 1899.)

In days when for the second time there has come from the East a call to universal peace, whatever be the nature of the response, men are naturally interested in that particular portion of the globe whence the summons has emanated. But even about that Asiatic portion of the corporate Russian Empire to which our attention is now turned, most of us have already formed some idea. Siberia is at once the reservoir of Russia and its cesspool. In the latter aspect it has been long known—the Siberia of Dr. Lansdell and Mr. Kennan—a country whose characteristic feature is dreary convict stations buried somewhere amidst snowy wastes, a land of gloom and desolation, to most who enter it the highway

[1] A sloop.

[2] Caravel or Carvel was a swift despatch-vessel with three lateen sails and square sail on foremast.

[3] S^ta^ Lucia, or Mangafiafy, north of Fort Dauphin.

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to the valley of the shadow of death. These notes are entitled "The New Siberia," because they are intended to suggest rather than to elaborate another and a truer point of view from which to regard that vast domain, to set before you some outline of the New Siberia which cannot at this moment be fully described, being only, so to speak, in the becoming, but which, none the less, will be the Siberia of the future.

Siberia is conveniently regarded as divisible into three broad east-and-west zones—the tundra farthest to the north, the taiga or belt of virgin forest, and the more open, largely agricultural, zone in the south. Between the last zone and the southern frontier still lie, especially in the west and in the centre, the steppe region and the Russian slopes of the Altai and Sayan mountains. Tundra is the name applied to the treeless belt of land that skirts the Arctic Ocean from Novaya Zemlya to Bering Strait, as far south, perhaps, as the 64th degree of latitude. There the subsoil is eternally frozen; in summer it is a swamp, where lichen and moss alone can maintain a hold of life. The average yearly temperature, *e.g.* at Beriozov on the Ob, at the south-western limit of the zone, is 5° C. below zero; that of winter—23° C. In that zone, likewise, is situated one of the poles of cold of our hemisphere, in the district of Verkhoyansk, where the January temperature is usually 49° C. below zero, and where a minimum of—68° C. has been registered. Any one starting from this point, therefore, finds himself in a peculiar position, because in whatever direction he goes the climate becomes milder. The climatic difficulty does not lie in the small number of degrees of heat registered in summer—we have hardly more—but in the relative shortness of the summer that succeeds the long winter, and in the great extremes that are reached within so brief a period. Hence, it is not easy to imagine how—unless in the event of such circumstances as have lately made Klondike appear to many to be a desirable place of residence—this tundra zone will ever be of service to the Russian Empire, or support a population other than that of the scant subarctic tribes to whom its wastes are home.

Gradually, almost imperceptibly, the tundra is overlapped by the belt of virgin forest. This taiga zone is the largest of the three; indeed it occupies almost half of Siberia. The climate is slightly less severe, although the yearly average is still below zero. The summer has lengthened, but agriculture is almost entirely impracticable unless with enormous trouble in certain well-favoured clearings. For the rest, it is an interminable maze of Siberian poplar, spruce, larch, cedar, fir, and pitch pine, with a dense undergrowth, a place of gloom below and silent conflict in mid-air. From the south, however, this forest belt is being slowly attacked with hatchets, and, as it were, pushed farther north, so that one day the land will support many more than the 700,000 Russians and natives who at present are resident within it.

If it is possible rudely to differentiate tundra and taiga by the absence or presence of tree forms, the criterion fails in the demarcation of the forest belt from the southern, open, agricultural zone. The latter, although it may rightly be termed open, is by no means bereft of wood; on the contrary, it is characterised by the presence of the silver

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birch, along with other species that are found in the true forest belt. The agricultural zone is, as one would expect, that southern strip where the climate is sufficiently mild to allow the cultivation of cereals. The line marking the limit, where the mean temperature does not fall below 12° C. during the period of vegetation, may be said to pass at first through Tobolsk and Tomsk; thereafter it continues gradually to droop towards the south-east till it reaches the 53rd degree of latitude on the Pacific coast. Again, it must be observed that the important factor is the relatively long summer. Leroy-Beaulieu, in a recent communication upon Siberia, illustrates this point by an apparent paradox:—"At Nertchinsk, in Trans-Baikalia, the winter is 4° colder than at Beriozov on the Obi, and although cereals ripen in the neighbourhood of the former town, the latter is surrounded merely by desolate tundra. The reason of this is that from May to September the mean temperature is 13·5° at Nertchinsk, and only 9° at Beriozov."

It is then in this southern zone that a reformation is being slowly wrought, due in the first instance to the passage through it of the Trans-Siberian railway. Into the history of this great undertaking there is no occasion to enter at this time. Suffice it to say that the idea perhaps first occurred to an English mind, and that no other Russian name is more closely connected with the initial steps than that of Count Muraviev, the annexer of Amuria. Winding across the illimitable plains of Orenburg, traversing the broad Urals, spanning wide rivers like the Irtish, Ob, and Yenisei, the railway creeps round the southern end of Lake Baikal, and mounts the plateau of far Trans-Baikalia. Thereafter, leaving behind it the Yablonovoi mountains, the line descends into the valley of the Amur, exchanges it presently for that of the Ussuri, and ends at last in Vladivostok. Such is, in brief, the original scheme to which imperial sanction was given on March 17th (O.S.), 1891.

To understand in part the far-reaching significance of this immense project, it may be well to glance at the conditions of travel which are thus being superseded along that particular track. It is exactly twenty years since Dr. Lansdell journeyed through Siberia, and by his route—down the Volga and up the Kama to Perm, thence by train to Ekaterinburg, whence to Tiumen by horse, down the Irtish and up the Ob to Tomsk, and thence along the *trakt* to Sryetensk, and so by water mainly to Vladivostok—it was possible to traverse the empire in two months. When the Trans-Manchurian trunk is finished, ten or eleven days alone will separate St. Petersburg from the Pacific terminus. Already, in 1896, the tarantass limit had been forced eastward to Krasnoyarsk; before this year has closed, or at the latest by the spring of 1900, there will be steam communication, *i.e.* by water and by land, right across the continent.[1]

Still there will be many who will not surrender the old summer

[1] The latest advices from St. Petersburg state that railway traffic was to be opened on December 18th, 1899, between Chita and Sryetensk, and that, consequently, on the commencement of navigation on the Shilka and Amur, the Russian capital will be in direct steam communication with Vladivostok.

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tarantass or winter sleigh without some feelings of regret. True, if an ordinary traveller, you could only make 100 to 120 miles, or even less, in the twenty-four hours; but then it was a glorious drive, now down a long avenue of brooding pine and stately larch that screened one from the strenuous rays of the sun, unless during the brief noontide hour, or that stood at other times spellbound beneath the winter frost; now through more open country, where land was laid under cultivation, and wattled fences were only used to enclose the common pasturage of a village; or again, as in far Trans-Baikalia, across bleak, wind-swept steppes, a prolongation of Mongolia. True, you had only perhaps three or four shaggy, impetuous ponies and a *yamstchik*, with whom you felt for a moment that you would rather not be associated. But then what a play was enacted before you! The mettlesome creatures were off ere the driver had well taken his seat, and at once there commenced the strange monologue that often only ceased when you had pulled up at your destination. Every incident in the team's behaviour was reflected in the continuous flow of the *yamstchik's* language, now gentle and rippling when his charges were drawing well, now torrential when one of them stumbled, shied, or showed signs of flagging—a quaint blend of blessing and cursing that rose and fell to the accompaniment of very expressive demonstrations of the flexibility of the driver's arms and whip. And the *yamstchiks* themselves, whose lives are spent in a continual going and coming between the station on either side of the particular posthouse to which they are attached—what drollery, bad temper, and deceit they could display! How, after a run of two or three miles out of the village, they would pause to give a breathing-space to their troika, dismount and closely scrutinise their harness to see what adjustments were required, and then amble round to the carriage to ask permission to smoke. This granted, they would fill a diminutive bowl with some mixture scraped out of an old pouch, would then retire behind the carriage, and, after a few whiffs, remount to their seat. How, on having pulled up at the door of a posthouse, they would come down and look you in the face, and tell you in one word—*Priyekhali*—the fact of which above all things you were most certain at the moment, viz., that you had arrived; how, sadder to relate, owing to some ill-timed conviviality they felt sleep to be preferable to duty, so that, as once happened to the writer in the middle of the night, one had perforce to mount and drive the drunken *yamstchik*. True, you may have covered long stretches alone or with a single companion; but then what strange processions trailed their slow lengths past your speedier equipage—chains of a hundred telyegas laden with tea and other Oriental merchandise, convoys of gold in charge of ready soldiers, waggon-loads of emigrants pushing towards an illusive east, gangs of remorseless convicts filling the air with alternate notes of gladness and despair. Nevertheless, through it all, there was a certain monotony, and, especially if one travelled by night as well as by day, a certain weariness about the older journey that find no place upon the Trans-Siberian railway.

When one puts to oneself the question, Out of what exigency did the idea of a Trans-Siberian railway arise? more than one consideration

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demands acknowledgment. Is it right to say that the scheme was probably but the development of sundry other lesser projects which had as object the providing of suitable means of communication in and with the eastern territories acquired in 1854, so that they might be the more easily exploited, and, in addition, colonised? Or was it that Russia during the Crimean war learned the disadvantage of carrying on a struggle in the absence of means of rapid connection with the basis of operations? The answer must include both of these considerations; nay more, the Trans-Siberian railway is first political, then economical.

As is now well known, there were three possible points of departure for the Trans-Siberian—Tiumen in the north, Zlatoust on the 55th degree of latitude, and Orenburg 3° farther to the south. Now the remarkable thing is that, fortunately, as it turned out, Zlatoust, the central point, was chosen; for Tiumen, in addition to being situated upon the Asiatic side of the Urals in the Siberian plain, was already joined by rail with Perm in European Russia, and through these towns lay the time-honoured line of entry to Siberia. Nor is it any counter-point to urge that it would have been necessary in that case to connect Perm with Nijni-Novgorod by six or seven hundred miles of rail, for such enterprise would have been justified, as even now the opening stretches of the Trans-Siberian run to the south of the colonised area. It would seem, however, that at the time when the decision was made the central point of departure commended itself because the line from it presented fewest difficulties in construction, and would be the shortest to any point in Central Siberia, as, *e.g.* Irkutsk, rather than because of any special economical advantages that it possessed; it is only comparatively lately that these last have been recognised.

The first section of the Trans-Siberian, viz., the Western Siberian railway, from Tchelyabinsk by Omsk to the Ob, 885 miles, was opened in 1895. Its construction offered no outstanding difficulty, unless in the building of the bridges over the Irtish and the Ob; in the latter instance the length of the iron lattice girder bridge exceeds 2500 feet. The same general remark applies to the Central Siberian railway—from the Ob to Irkutsk, 1168 miles—which, with the little 44-mile branch to Listvinitchnaya on the shores of Lake Baikal, was opened towards the close of the summer of 1898. On this stretch, however, is found the great bridge over the Yenisei, which was not to be completed till this year. In the case of the other smaller rivers, as *e.g.* the Tchulim, upon which Atchinsk stands, any difficulty connected with them lies not so much in the actual bridging as in the approach to the river, owing to the marshy nature of the ground and the frequency of inundations. Such swampy areas forming insecure foundations, and so demanding great expenditure of labour, are perhaps the most general serious obstacle with which the engineers have had to cope, confronting them even in the great western plain. The river Tchulim, with the long high embankment that leads up to its left bank, with nothing to correspond upon the other, because the right bank is just so much higher than the left, affords an illustration of the gradual displacement of rivers flowing towards the north that takes place in an easterly direction, owing to the rotation of the earth.

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The next section of the railway was to have gone from Irkutsk round the southern end of Lake Baikal to a station Misovskaya, a distance of nearly 200 miles. We have seen that already in 1898 a branch line had been laid from the capital to the shores of the lake, across which ply steamers with Scotch-built engines, thus following the old post route. It was always known that this short section would prove to be the most difficult, and Russian estimates had put its completion last. The initial surveys brought out the necessity amongst other feats of boring a tunnel over 12,500 feet in length on a continuous incline, so that it could only be attacked from one end, of erecting embankments, sometimes 112 feet in height, with proportionately high retaining-walls laid in cement, and of making endless cuttings in granite, gneiss, and sandstone. There is no doubt that this would have been the most romantic stretch of the railway, for the scenery around and in the neighbourhood of the lake is wonderfully picturesque, offering more variety in a given interval than is experienced on any other stretch over the 4000 miles. Since these preliminary investigations the section has been resurveyed more than once, and the latest advices point to an issue that had not been unforeseen, viz., its abandonment owing to the altogether disproportionate cost which its construction would entail. This, then, is the first great modification upon the original plan. The trains will be transported bodily upon ice-breaking ferryboats of 4000 tons, which are at present being put together upon the western shore of the lake. The distance to the railway port upon the other side is some forty miles, and it is expected that the passage will occupy ten hours in winter and three in summer. In addition to the usual periodical drawbacks to navigation upon Lake Baikal—the violent tempests and thick fogs—one cannot forget the difficulty that these vessels will surely have in merely getting under weigh during those four or five months when hitherto sledges and sleighs have been in requisition to cross the ice. On the other hand, should the new scheme prove entirely successful, it will represent a saving to the Government of a sum slightly under £2,000,000 sterling.

The next section from the eastern shore of Lake Baikal to Sryetensk, 673 miles, is that upon which labour and attention has been most recently concentrated. When it has all been opened, which, as already mentioned, was to be the case in this December, the steamers that run down the Shilka from that town into the Amur, and so to Khabarovsk, will form the connecting link between these two widely separated points upon the Trans-Siberian — a distance of over 1300 miles. And this brings us to the second great modification of the original plan. The fifth section, viz., that which, following the courses of the Shilka and the Amur, was to have joined the towns of Sryetensk and Khabarovsk by way of Blagovyeshtchensk has also been abandoned. This has been known for some time, but the more one looks into the matter and observes how practically no survey-work was done over this section, the more one feels convinced that the Russian Government never seriously meant to build it at all, but was quietly waiting till that favourable moment should arrive, as arrive it did in December 1896,

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when by the terms of the Cassini Treaty with China, it acquired the right of adding a Trans-Manchurian branch to the Trans-Siberian railway. The political and economical advantages of this concession have been flaunted in our eyes by perfervid patriots for the last two years. To begin with, there was even no actual post-road beyond Sryetensk; the river steamers in summer replaced by sleighs following the same frozen track in winter were the only means of communication with Blagovyeshtchensk or Khabarovsk. To build a railway would have necessitated the cutting of a roadway through the taiga that clothes the banks of the Amur. According to the plans of 1897 the Trans-Manchurian branch will be 1280 miles in length, 946 of which lie in Chinese territory, and it will mean a reduction of at least 350 miles—some calculate 700—on the original scheme. It joins the last section of the Trans-Siberian railway—the one covering the 486 miles between Khabarovsk and Vladivostok, opened already in 1897—at the station Nikolsk, sixty-eight miles north of the Pacific stronghold. This section will in future be known as the Ussuri railway, and Sryetensk will be the terminus of the Trans-Siberian railway proper. Previous to 1896 surveys had been quietly carried on by Russian officers and engineers in Manchuria, but even with the aid of these rather impetuous preparations it is difficult to see how the whole line of 4072 miles can be open before 1902.

The point of departure of the Trans-Manchurian, or Chinese Eastern, from the Trans-Siberian railway is Kidalova, a station lying fifty-three miles to the east of Tchita. Hence the line runs 600 miles directly south-east to Harbin. At this new town, some 500 miles west of Vladivostok, it crosses the Sungari. Thereafter the main line turns south to Port Arthur, 650 miles distant, while a south-easterly branch goes off to Vladivostok *viâ* Nikolsk, as already stated. Other branches from the main southern line will connect Kirin, Newchwang, and Pekin. Tchita, the capital of the oblast of Trans-Baikalia, is a quiet merchants' town, with a population of 10,000, prettily situated on the left bank of the river of that name, not far from where it falls into the Ingoda. The river Tchita is not navigable; but in earlier years certain individuals used to find pleasure and profit in making great rafts of wood, and gliding thereon down both the Ingoda and Shilka to Sryetensk, where, after disposing of the logs, they returned home by land. When the river was full, they were thus taken through beautiful scenery at the rate of six miles an hour, and could either live on whatever food they carried with them, or upon the wild duck and other fowl that frequent the banks. From the middle of the eighteenth century until 1851 Tchita was little more than a Cossack outpost, where there was always a good halting-point and settled market for merchant convoys on their way from Verkhni-Udinsk to Nertchinsk. In that year the boundaries of the territory were laid down, and Tchita was chosen as the principal town owing to its central position. Hence not only do the military governor and bishop of the oblast reside there, but the July review of all the troops in Trans-Baikalia, to which the inspecting general comes from Khabarovsk, is almost providential in its accessory function of wakening

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up the town once every year. Tchita contains all those institutions from a museum down to a prison, without which no Siberian town seems to be completely equipped, not to speak of a Chinese quarter, whose proximity to the Celestial Empire does not better the quality or cheapen the price of tea or silk. Trade to the extent of two million rubles is principally done in manufactured goods, dried fruits, and agricultural implements from Russia, wine, cigars, sugar, woollen and linen articles from Amuria, and tea from Kiakhta. The buildings are mostly of wood; the dusty roads boast of no paving. A line of posts sometimes marks off the portion allotted to pedestrians; not more than twenty street candles illumine the whole town. To winter there is not an enviable experience. Snow is a rarity, being seen once in ten years or so; but the severity of the frost is such that when one goes out of the mid-winter blazing sun into the shade of a wall or a house, the change in the temperature is almost unbearable. Otherwise the dryness of the atmosphere prevents one from feeling the full effect of the sharp cold.

Before we pass from the subject of the Trans-Siberian railway, it may be well to consider it as a whole. We have seen that the two important modifications leave its length to be the only serious difficulty connected with it. Again, to the west of Irkutsk, the line climbs no higher than 1900 feet above the sea; the summit is reached at 3400 feet in the Yablonovoi mountains. Some heavy cutting has had to be done in the narrow winding valleys of the Ingoda and Shilka, but there is not a single tunnel on the railway from one end to the other. On the whole one can say that it has not been an intrinsically difficult though a prodigious undertaking. But there are features that command our admiration. We have spoken about such and such sections being completed in so many years, but it is necessary to remember that these years represent actually only six months of labour. From October to April the soil is frozen so as to be unworkable; in the neighbourhood of the summit the ground thaws even in summer only to a depth of 2 feet, so that the perpetually frozen subsoil is reached only too soon. To do what has been done therefore required at times the co-operation of as many as 150,000 workmen. Certainly the greatest numbers came not from the native population, nor yet from penal settlements in any considerable proportion, but from European Russia went hundreds of peasants, content to labour during the summer, and either stay on or return, according as their duties to family and community were urgent or not.

The Trans-Siberian railway has not failed to arouse much criticism. There are those who say that the Russian engineers, little accustomed to mountains, and acting almost as if they were afraid of them, have laid the line sometimes through swamps, although elevations at no great distance would have afforded an excellent course upon their slopes; and to this error is attributed the frequent washing away of the line at so many points in Trans-Baikalia. Again, if any reasonable rate of speed is desired, the rails will all have to be relaid, those in use being lighter than the already too light ones employed in European Russia. Another

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step towards perfection will have been attained when the larger wooden bridges are reconstructed in iron. The estimated cost, £34,700,000, it is needless to remark, will be greatly surpassed, even when the economies resulting from modifications are taken into account; in some measure this excess is the outcome of waste and carelessness. Still, the actual execution of the work is beyond praise, and the Trans-Siberian railway will remain the great monument to Russia's industry in the nineteenth century, reflecting in some measure the national characteristics of simplicity and greatness.

But the New Siberia is also a country open to, and exercising a certain fascination over the minds of, thousands of emigrants. The point to be observed is not that emigration eastward is first noticeable in the last decade, or even the last half-century—for Siberia received her earliest immigrants in the sixteenth century; what rather is worthy of remark is the essential difference from a general point of view between the former and the latter movements. The one was compulsory—the emigrant was first an exile, then a colonist; the other is spontaneous —the emigrant is first a colonist, then, if you will, a voluntary exile. Every one is aware how at one period in our history the Pilgrim Fathers left these shores and founded a colony across the sea, from which has sprung much of what is best in the America of our time; how at another, representatives of a class nearer the other end of the social scale were sent in the opposite direction to occupy the lands around a certain Botany Bay; how again yet others went to India to carry on and, when necessary, protect an expanding trade, and in a few years gave us an empire. Now there have been exactly the same movements from Russia, with this difference, that they all tended in the same direction. The rich merchant family of the Stroganovs, in whose pay was Yermak, the so-called conqueror of Siberia, received from Ivan the Terrible just such a charter of privileges as was granted to the British East India Company. It would make you smile were one to relate the trivialities that sent thousands of dissenters across the Siberian border in the seventeenth century, while, if we include the relatives who have accompanied the convict bands, not far short of a million banned souls must have entered Siberia since 1820. Every country has its Via Dolorosa, and the old post-road leading from Perm to Tiumen well merits that appellation. But what is the result to-day? The original Russian population of Siberia is mainly drawn from three sources—the Cossacks who first conquered the country, the exiles, political and criminal, and the great band of religious dissenters. Now, if we consider these three classes, bearing in mind with regard to the second that the unfit criminal exiles are weeded out by natural selection and do not survive, we see that, as a whole, they consist of men and women who were in some way, intellectually or physically, more active or more earnest than their fellow-countrymen who remained in European Russia. The result is that to-day the average Siberian is a more vigorous and intelligent man than the average Russian. He picks up a thing more quickly; his life is richer, brighter. There is, on the whole, a greater approximation to a normal state of existence in Siberia than in Russia; and the

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political exiles are not slow to see this, and take advantage of it by remaining on when their term is finished.

The new voluntary emigration movement really runs parallel with the progress of the Trans-Siberian railway scheme, for prior to its commencement certain restrictions had been laid upon intending colonists. But with the new era the Government encouraged intending settlers in many ways. They were taken out by rail at rates corresponding to less than one shilling to the hundred miles. On their arrival in Siberia, they received in the western Governments grants of forty acres of land each, and were exempted from taxes for three years, while in many of the hardest cases temporary financial relief was granted to an extent not exceeding £10. It is now matter of history how in the spring of the coronation year 1896, when the western section of the railway was first opened, the number of emigrants, which for some years past had been slowly rising, suddenly reached a point that exceeded the transporting capabilities of the young Trans-Siberian railway. There was neither the necessary rolling-stock nor sufficient officials to conduct the emigrants to the grants that had been allotted to them. As far east as Atchinsk we saw them by the side of the line or round the larger stations in hundreds, waiting—one man said he had reached the point a month ago—pining, dying from various epidemics, before the time came when the bewildered conductors could lead them to their new homes. The matter was thoroughly investigated, and a like accident will not recur. But in spite of the numbers that have returned home to European Russia, having spent their all upon a fruitless errand, the fascination of the new country grows yearly stronger, and it is probably little exaggeration to say that, since Nicholas II. formally ascended the throne, an annual average of 200,000 people has gone out to claim a lot and portion in this new Land of Promise. An interesting comparison could be worked out between Siberia and Canada, which would show, amongst other things, that in the matter of actual colonisation, under conditions much less favourable, the Eastern Dominion has made relatively the greater progress, the difference in density of population between these two northern territories being merely fractional. Further, unlike the circumstances under which various countries have been and are being colonised by Anglo-Saxons, there is nothing in Siberia corresponding to colour prejudice. With its several indigenous Mongol peoples the western Slav has a certain natural affinity, while on the question of religion, where alone there could be any possibility of serious disagreement, the Russian as an individual is essentially tolerant. At the same time, like Australia and North America, Siberia is confronted with the problem of the Chinese overflow. Owing to the relative geographical positions of Siberia and China it is probable that this problem will reach a more acute stage in Northern Asia than elsewhere; at present the Russians regard it with sublime indifference. The Chinese, who are found only in the towns, do not seem to enter into the official immigration reckonings. Hence it is possible to say that, with the exception of a few French, Siberia is being colonised by subjects of the Tsar.

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Reference has already been made to the Raskolniks, or Dissenters, as forming part of the original Russian population of Siberia. To-day they number at least one hundred and twenty thousand, and are most numerous in the provinces of Amur and Trans-Baikalia. Temperate and industrious, they are generally admitted to be the best native Russian element. In these two qualities, as in much else, they contrast very forcibly with the orthodox peasants, who are characterised by idleness, a certain obstinacy, and a lack of energy and perseverance.

Whatever differences exist between Asiatic and European Russia are merely differences of degree. In the sphere of the natural, the tendency is towards exaggeration. Thus, Siberia is the larger country, her plains have a wider sweep, her rivers follow a longer course, her forests cover a wider area, her winters are more severe and more extended. In the realm of the artificial the tendency is just the other way. The official hand lies lighter; class distinctions have reached the vanishing point where there is practically only one large class, and where there never was serfdom; orthodox ecclesiastical injunction has not the same binding force where heterodoxy peacefully thrives. Now, as in Russia, the people are essentially agricultural, only more so. As in Russia, the peasants live almost entirely in villages or hamlets, which are more simple, if possible, than those on the western side of the Urals. The soil in the southern zone of Siberia is often very rich; much of the provinces of Tobolsk and Tomsk is overlaid with the famous *tchernoziom* (black earth). The virgin tracts are remarkably prolific, and thirty to forty crops are often gathered in without any prolonged interval of repose. Further, there is a great abundance of live stock in peasant hands, especially of horses; cattle are not often used as beasts of burden or for purposes of draught, while breeding rarely ranks as an occupation. The transport of the interminable caravans of tea and other merchandise, travellers and convicts, always to be seen upon the great post *trakt*, has hitherto proved an assured source of revenue to the villagers along that route. And so there has never been a struggle for existence in the Siberian peasant's life; means of subsistence lie at his hand; beggary is unknown. In spite of this he is characterised by idleness, a certain obstinacy, and a lack of perseverance and energy, and he possesses these qualities, these failings, in a more marked degree than his western compatriots. With regard to these last two traits of national character it may be interesting to discuss whether they have existed from all time, whether they are vestiges of the ancient Tartar domination, or whether they are the accumulated hereditary effects of many long, dreary winters; it would be more profitable to endeavour to ascertain through what means the Raskolniks have in great part succeeded in overcoming these defects.

But in the New Siberia there are important modifications in the old state of affairs as depicted above. With the development of colonisation it is no longer possible for the Siberian peasant simply to remove to some other locality when the land upon which he has been working becomes impoverished. Further, with the aid of manure (hitherto unused) and modern implements, his cultivation of the soil will tend to be more

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serious and systematic, one result of which—already felt in the western-most districts—will be a greater constancy in the annual amount of grain produced, and consequently less variation in the price. And if the railway does on the one hand deprive him of much of his transport revenue, on the other, by providing means of export for his surplus grain, it rouses him in earnest to agricultural pursuits. Cattle-breeding also, hitherto confined to the Buryats, in Trans-Baikalia, and to the Kirghiz in the south-western steppes, begins to appeal to the Siberian peasant as an end in itself, and traffic in dairy produce naturally associates itself therewith. Thus everywhere the old sloth that hindered a man from doing more than was absolutely necessary is being thrown off; competition induces struggle; the New Siberia is a realm of life.

We have seen that the Siberian soil is often rich, but the subsoil is richer still. Amongst the gold-producing centres of the world the Russian empire takes the fourth place; two-thirds of its contribution come from Siberia. Hitherto, owing to unsatisfactory means of communication, it has not been found possible to convey to the often far-removed gold districts the machinery necessary for such an operation as quartz-crushing. In consequence Siberian "gold-mining" has been till quite recently restricted to the exploitation of placers, and even the washing of these auriferous sands has been conducted with little thoroughness. By one of the conditions under which the land is leased to speculators of any nationality the State constitutes itself sole buyer of all the gold, at the same time imposing a double tax on the output and on the amount of land leased. This somewhat ill-conceived legislation lends itself to numerous abuses, which are however in process of being remedied. Accordingly, with more satisfactory official regulation and the introduction of modern plant, gold-mining promises to be a leading feature of the New Siberia. And when to this is added the imminent working of numerous coal seams, more or less recently discovered, not to speak of the great iron and copper beds that are scattered up and down this immense territory, we see the extraordinary richness of this brightest jewel in the Russian crown.

One final word about the towns. At the beginning of the present decade it would have been possible to count off those with a population exceeding ten thousand inhabitants upon the fingers of one hand; to-day there are at least a dozen such centres of population. With three or four exceptions they lie along the line of the post *trakt*, that is, of the railway. With one or two exceptions they are still administrative as well as commercial centres. In the eastern towns the administrative element is the more prominent; in the western the commercial element predominates. From these towns are distributed the manufactured articles that are sent out from European Russia: there also are collected the surplus produce of the circumjacent districts previous to their despatch westwards. In configuration they may all be said to adhere to the composite type of the ordinary provincial Russian towns, with streets parallel and at right-angles, of small wooden houses enclosing a nucleus, greater or smaller, of buildings in stone; these are either official, educa-

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tional, or commercial establishments. Any street paving is done in wood; electric light and the telephone are not unknown. Already there is a certain differentiation in the character of the towns. Tomsk, by reason of its university with faculties of medicine and law, is the intellectual, as Irkutsk is the commercial, and Vladivostok the naval, capital. As, naturally, it is in the towns that we should expect to find the earliest hints of what the future of the country will be, these few sentences must suffice to indicate the civic outlook of the New Siberia. In every way her material prosperity seems assured. But, on the contrary, nearly everything remains to be done to develop in a corresponding manner the enormous field of Siberian peasant intellect. Only when this is accomplished will there be ultimate satisfaction in the New Siberia.

OBITUARY: 1899.

Sir J. WILLIAM DAWSON, C.M.G., LL.D., F.R.S.—The subject of this notice was born at Pictou, Nova Scotia, in 1820, at which place he received his preliminary education. He subsequently studied in the University of Edinburgh, and returning home devoted himself chiefly to the study of Palæontology and Geology. From 1843 almost to the end of his long life not a year passed without one, usually several, contributions from his pen to scientific journals and periodicals. Besides these papers, some of which were elaborate enough, he wrote also a number of monographs, of which the most important is one dealing with the Devonian and Carboniferous floras of Eastern North America. In all these works he gave evidence of keen observation and clear perception of the problems which called for elucidation. We are indebted to the same busy pen for numerous independent publications—not a few of which, being popularly treated, have been widely read and much appreciated. The work which first brought the author into prominence was his *Acadian Geology* (1855). This admirable book embodied the results of his researches in Nova Scotia and New Brunswick, and is likely to survive as one of the classics of geology. But probably Sir William was best known as the discoverer of Eozoön Canadense—the oldest relic of animal life. The organic origin of this "fossil" having been called in question, a prolonged discussion ensued, leading to the publication of *The Dawn of Life*—an interesting work in which Dawson reviews the evidence and replies to his critics. The author was conservative in his scientific views. He was opposed, for example, to the Darwinian theory of the origin of species, which he endeavoured to controvert in his *Story of the Earth and Man*. He also stoutly maintained the marine origin of the "drift deposits" of North America, believing that the boulder-clays and erratics of Canada and the Northern States of the Union were the droppings of icebergs—a view to which he was unable to convert any of his American confreres. But in this, as in many other departments of geological inquiry, he nevertheless made solid contribu-

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tions to science, which will continue to form part of the common stock of knowledge long after many of the theoretical views held by him and opposed by him have been superseded. When the history of science during the century that is closing comes to be written there can be little doubt that Sir William Dawson will take a prominent place among the *viri illustres* of geology.

As Principal and Vice-Chancellor of M'Gill University for the space of nearly forty years, Sir William played a prominent part in the educational life of Canada, and was looked up to and venerated by all. He was selected by the Governor-General, the Marquis of Lorne, to be the first president of the Royal Society of Canada in 1882, and in the same year presided over the American Association for the Advancement of Science. His attainments, it is needless to say, were duly recognised in this country. He was elected F.R.S. in 1862; received the Lyell Medal of the Geological Society of London in 1882; obtained the degree of LL.D. from Edinburgh University in 1884, in which year also he received the honour of knighthood; and was President of the British Association at Birmingham in 1886. He died at Montreal on November 19th.—J. G.

Lieut.-Col. Sir R. LAMBERT PLAYFAIR, K.C.M.G., LL.D.—Grandson of Principal Playfair of St. Andrews University, son of the Chief Inspector-General of Hospitals in Bengal, Sir Lambert Playfair was born at St. Andrews on 21st March 1828, and died there on 18th February 1899, after a long and useful career, during which he distinguished himself as a discoverer, an administrator, a geographical writer, and as H.M. Consul-General for Algeria.

Having been educated at St. Andrews and Addiscombe, he entered in 1846 the Royal Madras Artillery, and was selected in 1854 by Sir James Outram as his Assistant Political Resident and Commandant at Aden. Whilst there he rendered permanent and inestimable service to the garrison and population of Aden by discovering the ancient reservoirs, the origin of which is lost in antiquity. An account of this discovery was given by him in his "Reminiscences," published in *Chambers's Journal* (Dec. 1898—May 1899). On the restoration of these reservoirs, whereby twenty million gallons of water were stored for public use, the largest reservoir was named the "Playfair Tank."

Playfair's next achievement was his taking definite possession in 1857, in name of the East India Company, of the island of Perim in the Straits of Bab-el-Mandeb. A French Consular Agent had hinted to the Aden authorities the possibility of his Government occupying Perim, so, although it had previously been taken possession of by the East India Company, they put the matter beyond doubt by sending Playfair to take possession of it once more.

Owing to an unprovoked outrage on Captain Burton in 1854, a British fleet blockaded Berbera during an entire year. Playfair was then sent over and concluded a treaty with the Somalis, one clause in which was, "The traffic in slaves shall cease for ever." This engagement having been evaded for years, he was again employed to enforce it, and also to

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punish the murderers of British sailors on the coast of Somaliland. This task he successfully accomplished after an interview with the Sultan in 1862.

Next year Playfair was sent to Zanzibar as Political Agent, and in 1865 was appointed H.M. Consul-General for Algeria, a post which he held for the long period of thirty years, during which he exhibited the greatest ability, activity, and urbanity. In 1877 he published a 4to volume, entitled *Travels in the Footsteps of Bruce in Algeria and Tunis*, whilst by making himself intimately acquainted with the shores of the Mediterranean, he became a leading authority on the subject, as testified by his Murray's Handbooks to the Mediterranean, and to Algeria and Tunis. In 1884 he contributed a volume entitled, *The Scourge of Christendom: Annals of British relations with Algiers prior to the French Conquest*, based on official Algerian documents.

As President of the Geographical Section of the British Association in 1890, Sir Lambert delivered a valuable address on *The Mediterranean, Physical and Historical*, which will be found in the Society's *Magazine* for that year. In 1892 appeared *A Bibliography of Morocco, from the Earliest Times to the End of* 1891, written by Playfair in collaboration with Dr. Robt. Brown, a work which is a monument of industry and research.—R. R.

HEINRICH KIEPERT—1818-1899.—Among the geographers and cartographers of the nineteenth century no name is better known than that of Professor Heinrich Kiepert. By all English students of Classical Geography his works have for long been recognised as standard authorities.

Johann Samuel Heinrich Kiepert was born at Berlin on July 31, 1818, where his father was a successful merchant. He was educated in his native city, and at an early age showed a decided bent for the study of history and geography. Entering the University of Berlin in 1837, he devoted himself more especially to classical research and philology, while in geography he was a devoted student of Karl Ritter, and it was mainly owing to Ritter's influence that he determined to devote himself entirely to geography and cartography. His first important work, undertaken in conjunction with Ritter, was an *Atlas of Hellas and the Hellenic Colonies*, in twenty-four sheets, issued between 1841 and 1846, which at once gained for him a great reputation among classical scholars. This work was followed by a laborious editing of Robinson's Survey of Palestine, a subject on which Kiepert ranked as a leading authority.

In 1845 he made his first scientific journey to Asia Minor, and from that time it became the favourite field of his labours and the subject of his best-known piece of original work, with which his name will always be specially associated.

Kiepert is, however, best known to the public by his general work as a cartographer. In 1845 he undertook the direction of the Geographical Institute at Weimar, where he extended his experience in the technique of cartography, and in 1848 he published his first Atlas of the Ancient World. After seven years at Weimar, on the advice of

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Karl Ritter, he went to Berlin, where in 1854 and 1855 he issued his well-known *Hand Atlas* of the world and his *Atlas Antiquus*. He was then appointed a member of the Academy of Sciences and in this capacity became Professor of Historical Geography in Berlin University in 1859. A few years later he also undertook the direction of the Topographical Section of the Statistical Office. From this time onwards Kiepert pursued his duties as Professor at Berlin, combined with frequent exploring journeys to Asia Minor, Palestine, Greece, and Italy, while his activity as a cartographer was constant. His classical wall-maps, his series of globes, his archæological and statistical survey of Italy, and, last and most important, his great map of Asia Minor on the scale of 1 : 500,000, which he did not live to complete, are among his best-known works. Kiepert was also the author of the *Lehrbuch der alten Geographie*, and *Leitfaden der alten Geographie* (1879); also of numerous papers mostly dealing with ancient oriental geography.

Living to the mature age of eighty-one, he was active to the last, and until a few months before his death on April 21, 1899, continued to devote himself to editing his great accumulations of material, the result of years of travel and research. This work, although left unfinished, is now in the hands of his son, Dr. Richard Kiepert, and will in all probability be published shortly.

In conclusion, we may add that Germany is largely indebted to Professor Kiepert for the leading place in scientific geography and cartography which she occupies to-day.—J. G. B.

Dr. OSKAR BAUMANN.—One of the most useful of recent African explorers died in Vienna on October 12, 1899.

Dr. Oskar Baumann, who was born on June 25, 1864, at Vienna, was well known to the writer of this notice. The last letter he had from him was from Zanzibar. In this letter he indicated his idea and hope that Great Britain would occupy Fernando Po, an island which he had visited and well described in 1888.

A Ph.D. of Leipzig, an ex-officer in an Austrian regiment, Baumann commenced geographical exploration in 1885 on the Congo in Dr. Lenz's expedition. His work was admirable, giving as it did the first and best description of the Lower Congo. Then followed his book on Fernando Po, where he had gone to recruit his health.

In 1888 we find him in East Africa, and his book *In Deutsch-Ostafrika während des Aufstandes* (1890) gave us the best work on Usambara which we possess.

This work was followed by *Usambara und seine Nachbargebiete.*

Another expedition soon followed, resulting in his graphic and detailed description of his journey to the Victoria Nyanza. *Durch Massailand zur Nilquelle* (1894) is just what a book of exploration ought to be.

Dr. Baumann was appointed Austrian Consul in Zanzibar in 1896, and he used his spare time in investigating the islands of Mafia and Zanzibar.

He was a careful explorer, a genial companion, a writer of some

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power, but not prolix. The work he has done in Africa will long be remembered, and we can only urge other explorers to follow in his footsteps and give us the same vivid yet accurate work.

Dr. Baumann is much regretted by all who had the pleasure of his personal acquaintance.—R. W. F.

Vice-Admiral PHILIP HOWARD COLOMB.—It is with deep regret we heard of the death of Vice-Admiral Colomb, which occurred quite suddenly at his residence, Steeple Court, Botley, Hants, on the 13th October.

During his service afloat, he had seen a good deal of active work. While pirate-hunting in China on board H.M.S. *Reynard*, he was wrecked in 1851. He was then appointed to H.M. Brig *Serpent*, in which vessel he was present at the attack and capture of Rangoon, and the first phases of the Burmese war, 1852. He was also a lieutenant of the *Hastings* in the Baltic during the Russian war, and was present at the bombardment of Sveaborg in 1855. In command of H.M.S. *Dryad*, he aided in the suppression of the slave-trade from 1868 to 1870 on the east coast of Africa. He was Flag-Captain to Admiral Ryder in China, 1874-77, and held various other appointments until his retirement in 1886. Of most interest, from a geographical point of view, is his voyage to the Arctic seas in the *Phœnix*, which under Captain Inglefield was sent to the relief of Sir Edward Belcher's expedition in 1854.

As *The Times* remarked in its obituary notice of the gallant admiral, "The naval thought of our time is appreciably poorer by his death." He was certainly a man of original ideas, and was one of the first to foresee the changes that steam and rifled ordnance would produce in naval warfare and tactics.

He served on various committees appointed by the Admiralty; he also simplified and improved the method of signalling adapted to the greater mobility of ships propelled by steam, and it is hardly too much to say, that there are very few departments of the navy which have not felt his influence.

He was a gold medallist of the Royal United Service Institution, Younger Brother of the Trinity House, lecturer on Naval Strategy and Tactics at the Royal Naval College, Greenwich, 1887-88, and author of numerous works—*The Dangers of the Modern Rule of the Road at Sea*, etc.

Admiral Colomb was in London as late as 12th October, and apparently in his usual health and vigour, speaking of the literary tasks on which he was engaged, and discussing current topics with unabated insight and acumen. The next night he was dead. Admiral Colomb on one occasion lectured before the members of the Royal Scottish Geographical Society, giving them an interesting and lively account of the voyage and wreck of H.M.S. *Reynard* in the China seas, in which ship he served as a midshipman.—H. D.

Sir ALEXANDER ARMSTRONG, K.C.B., F.R.S.—On July 4th, Sir A. Armstrong died at Sutton Bonnington, near Loughborough, at the age of eighty-one. After studying at Trinity College, Dublin, and taking

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a medical degree at Edinburgh University, he entered the Royal Navy in 1842. In 1849 he was appointed as surgeon and naturalist to the *Investigator*, which, under Captain Sir Robert M'Clure, sailed to search for Sir John Franklin on the western side of the North American archipelago. After four winters in the ice the crew of the *Investigator* returned to Europe by Baffin's Bay, having made the North-West passage with sledges over the frozen sea. Sir Alexander Armstrong described the events of the expedition in *A Personal Narrative of the Discovery of the North-West Passage*, published in 1857.

Before his return to Europe the Crimean war had broken out, and in 1855 Sir Alexander Armstrong was called to active service with the Baltic fleet. He rose to the highest posts in the medical service, and in 1869 became Director-General.

VICTOR GIRAUD was born at Morestel in the Department of Isère in 1859, and died at Plombières in the Department of the Vosges on August 22nd at the early age of forty. In 1882, when he was a lieutenant in the French navy, he obtained leave of absence in order to conduct an expedition in Africa, his object being to march inland from Dar-es-Salaam and explore the lakes Bangweolo and Mweru, and cross to the west coast. M. Giraud was an acute and accurate observer, and his book *Les Grandes Lacs de l'Afrique Équatoriale*, published in 1890 (*rev.* vol. vi. p. 499), threw considerable light on the geography of the Nyassa-Tanganika plateau and the neighbourhood, and subsequent exploration has proved the accuracy of the descriptions he gives of the places he personally visited. Being prevented from crossing the continent by a mutiny among his porters, he was obliged to return by the Shire river, which he descended with Mr. Montague Kerr. He reached Zanzibar in November 1884.

With this journey M. Giraud's explorations began and ended. He returned to his duties in the French navy, having gained a high reputation among African explorers.

THE CALENDAR.

THE special table in the English Prayer Book showing the days on which Easter falls ends with the year 1899. This is no arbitrary limit, but is determined by the fact that in 1900 a disturbance takes place in the ordinary course of the years, which renders necessary certain alterations in the Calendar. This, then, is an opportune moment to explain how the Calendar is arranged, which the excellent notes on the subject by Mr. Blaikie, attached to his *Star Maps*,[1] enable us to do. The sub-

[1] *Monthly Star Maps for the Year* 1900. With Notes on the Luni-Solar Calendar and the Incidence of Easter, together with an Explanation of certain Unusual Occurrences in the Calendar of 1900. By Walter B. Blaikie. Edinburgh, The Scottish Provident Institution, MCM.

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ject is one of considerable intricacy, and the various systems that have been employed are fully described only in books not easily procurable. We cannot follow Mr. Blaikie through the whole history of the Calendar, but shall confine ourselves chiefly to those details which are connected with the Calendar in its present state.

Beginning with the Solar Calendar, which is the simpler, we need not refer to any earlier reformer than Julius Cæsar. In the year B.C. 45 he revised the Roman Calendar, arranging it as regards the months and the number of days in each, just as it is now, except for a few changes subsequently made by Augustus, an intercalary day being introduced every fourth year. The average length of the year was 365¼ days. Until the year 1582 this Calendar was used by the Christian nations in Europe, but the year did not begin on the same date in all countries. In England, Christmas Day was also New Year's Day until the twelfth century, when the beginning of the year was moved to March 25th.

The solar year, however, is a little less than 365¼ days, and as the centuries passed on, the actual date of the spring Equinox differed more and more from the date as given in the Calendar. In the sixteenth century the divergence had become so marked that Pope Gregory XIII. determined that the Calendar should be reformed, a task which was satisfactorily completed by a German Jesuit, Christopher Schlüssel, better known by his Latinised name of Clavius. According to the latest calculations, the solar year is 11 minutes 14 seconds less than 365¼ days. In four hundred years the accumulated error would be 3 days, 2 hours, 53 minutes, and 20 seconds, and therefore it was decided that every centurial year not divisible by 400 should not be a leap year. The extra day was therefore omitted in 1700 and 1800, and will be in the present year. There still remain about 2 hours and 53 minutes in every four hundred years to be accounted for; but it will be so long before this error accumulates to one day, that its rectification need not be discussed. The date of the Equinox was in the Gregorian Calendar to be restored to its position in the year as fixed by the Nicene Council, A.D. 325, and therefore 10 days were omitted in 1582. The new Calendar was adopted at different times by European countries—by England in 1752, when 11 days were omitted, October 1st being followed by October 13th; at the same time January 1st was made the first day of the year.

To draw up a Lunar Calendar was found to be a much more difficult task. The Jewish Passover was on the 14th day of the moon which became full after the Equinox, and the Christian Church was also obliged to take the moon as a time regulator, in order that Easter Day might follow closely on the Passover, as the Resurrection of our Lord actually did. At the same time the Fathers of the Church wished to avoid keeping the Easter festival on the very day of the Jewish Passover, and therefore, at the Council of Nicæa, it was decreed that Easter Day was to be held on the first Sunday after the 14th day of the moon that occurred on or after the Equinox, and if the 14th day of the moon were a Sunday, Easter Day was to be the Sunday following. Three points had therefore to be considered:—(1) Easter Day must come after the Equinox, and therefore depended on the solar year; (2) it must fall after the 14th

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day of the moon, and therefore depended on the lunar cycle; and (3) it must be on a Sunday (the first day of the week).

Beyond these regulations, no system was set forth at the Nicene Council by which to regulate the incidence of Easter, and consequently Easter was kept on several different dates in the various countries of Christendom, no regular system being introduced until about the year 532, when Dionysius Exiguus, a Scythian monk, made a reckoning based on the Metonic Cycle, and fixed the era at the end of the year 753 of the founding of Rome, which has been retained ever since, though it was afterwards discovered that our B.C. 4 was most probably the year of the Nativity.

Were the length of a lunation a measure of that of a solar year, Easter Day would recur every year at the same date, and no ambiguity could have arisen. But the lunations vary in length, and an average lunation is about 29½ days. It was, therefore, necessary to find a cycle of lunations and a cycle of solar years which should contain as nearly as possible the same number of days. This was done by Meton, an Athenian astronomer (B.C. 432). His system has never been presented so clearly and concisely as by Mr. Blaikie. It was assumed that 235 average lunations were equivalent to 19 solar years of 365¼ days each, and to 6939¾ days. As the average lunation is 29½ days, Meton made his ordinary lunations 30 and 29 days alternately. Twelve ordinary lunations would thus amount to 354 days, leaving 11 days over in an ordinary year. These surplus days would in 3 years amount to 33 days, from which an embolismic or intercalary month of 30 days was formed. Thus in 18 years there would be 6 embolismic months, leaving 18 days over, which, with the 11 days of the nineteenth year of the cycle, made a seventh embolismic month of only 29 days. As for the 4¾ days which it will be found are needed to make up the number 6939¾, they are the extra days of the leap years, and need not be specially noticed when they are included in both the solar and lunar years, for it is the variations between these years that alter the incidence of Easter. The numbers of the years in the cycle—1 to 19—were inscribed at Athens on the temple of Minerva in letters of gold, and hence are still known as Golden Numbers.

What the Julian Solar Calendar is to the Gregorian, the Metonic Cycle is to the Dionysian and Gregorian lunar reckonings. It has only needed some slight modifications to make it answer every purpose. Dionysius calculated Easter by a combination of the Metonic Cycle and a Solar Cycle of 28 years devised by Victorius, Bishop of Aquitaine.

The seven letters, A, B, C, D, E, F, G, are placed in the Calendar beside the days of the months, recurring in their natural order throughout the year from January 1st. In any one year the letter attached to a Sunday is always the same; thus, if January 1st be a Sunday, its Dominical or Sunday Letter is A, and every other day in the same year to which the letter A is attached is also a Sunday. As there are 52 weeks in the year and one day over, January 1st of the succeeding year will be Monday, and its letter will be A, so that the letter G will be the Sunday Letter for that year. After seven years, then, the Sunday Letter

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would again be A, were it not for the disturbance caused by the leap years. In these years no letter is appended to February 29th, and therefore the following Sunday comes one place earlier in the series of letters. From this leap of the Sunday Letter Mr. Blaikie derives the name "leap year." A combination of the seven-year period of the letters and the four-year period of the leap year, or twenty-eight years, forms thus a Dionysian Cycle, in which the Sunday Letters form a complete series, always recurring in each succeeding cycle. If this cycle be again combined with the Metonic Cycle of nineteen years, we get a cycle of 532 years in which the dates of Easter Day perpetually recur. The reason that the Dionysian reckoning is no longer in force is that it was based on the Metonic Cycle, which was not quite correct either as regards the solar year or the lunations.

The starting-points of the Dionysian Cycle are, however, important, for they are still retained. Dionysius decided that in A.D. 1 the Sunday Letter was B, and the Golden Number 2, that is, he reckoned that a Metonic Cycle commenced in B.C. 1. Hence the rule to find the Golden Number is:—Add 1 to the date of the year and divide by 19; the remainder is the Golden Number. We have seen that the Sunday Letter is thrown back one place every year, and an additional place every leap year. The date of the year gives the retrogradation of the Sunday Letter since the beginning of the era, and one quarter of the same number, neglecting fractions, gives the additional retrogradation due to the leap years. Adding these sums together and dividing by seven, we get a number which shows the position of the year in the cycle of seven years. As the seven-years period began in A.D. 1 with B, it ends with C, and, supposing that the remainder is 4, the Sunday Letter of the first of these years is B, of the second A, of the third G, of the fourth F, which is therefore the Sunday Letter of the year in question. To obviate the necessity of thus reckoning backwards, a number is assigned to each of the Sunday Letters, and the use of these numbers is explained in the Prayer Book. Since the introduction of the Gregorian Calendar this calculation requires a slight modification, owing to the omission of February 29th in certain years.

We need not linger longer over the now obsolete Dionysian Cycle, but may pass on to the improvements introduced by Clavius. As the year of the Julian Calendar was a little too long, so also was the length of the Metonic Lunar Cycle, the difference amounting to 1 hour 29 minutes, or, roughly, 8 days in 2500 years. To rectify this error, Clavius proposed to omit a day at the end of seven periods of 300 years each, and again at the end of the succeeding 400 years, the first correction to be made in the year 1800. Between the year 325 and the year 1582 the day ought to have been omitted four times—in 500, 800, 1100, and 1500—but Clavius purposely deducted only three days, in the vain hope of preventing Easter Day from ever coinciding with the Passover. This object has not been attained because the moon of the Metonic Cycle is the conventional "Ecclesiastical" moon and not the moon of the heavens.

In the old system, the embolismic months were carefully arranged among the ordinary lunations, and many arbitrary rules were laid down

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regarding the number of days in each month. Clavius simply made the ordinary lunations 30 and 29 days alternately, and in order to reckon Easter Day from the beginning of the year made use of epacts. The epact of any year is the age of the moon on the morning of January 1st. How they were worked will best be seen by examining the epacts for a whole cycle. Those for the cycles of the past 200 years are as follows:—

Golden Numbers,	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
Epacts,	0	11	22	3	14	25	6	17	28	9

Golden Numbers,	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.
Epacts,	20	1	12	23	4	15	26	7	18

In the explanation of the Metonic Cycle it was mentioned that after the 12 ordinary lunations in the year had been allowed for, 11 days remained over. Therefore as the year I. in the above cycle begins with a new moon, 11 days remain over as the epact for year II., and the third year has an epact of 22. Again adding 11 days, we get 33 days, 30 of which form an embolismic month, while the remaining 3 are left over as the epact of year IV. This process is repeated until we come to the last year of the cycle, which has 18 as epact. Now, on looking through the line of epacts, we see that the number 30 has been dropped six times, representing the six embolismic months of 30 days each. A seventh of 29 days has to be accounted for, and this is done by adding 11 to the last epact. The cycle then ends on December 31st, and the succeeding cycle begins again with new moon. The epacts for the set of cycles which has just commenced are as follows:—

Golden Numbers,	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
Epacts,	29	10	21	2	13	24	5	16	27	8

Golden Numbers,	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.
Epacts,	19	0	11	22	3	14	25	6	17

Here we see that 30 has been dropped seven times, so that the last embolismic month is one day too long. Consequently the moon at the end of the cycle is a day too young; it would be 28 days if only 11 days were added, as usual, but it must receive another day, making it 29 days old. The general rule, then, is to add 12 days instead of 11 to the last epact of the cycle.

The next question is why the epacts are changed this year. As the epacts depend on both the solar and lunar cycles, they must be affected by any change that takes place in the one and not in the other. The year 1700 was not a leap year, and therefore the epacts were changed; the year 1800 was not a leap year, but the lunar correction was also applied, so that there was no disturbance; the year 1900 is not a leap year, and there is no lunar correction, so that the epacts are changed. The year 2000 is a leap year, and in 2100 the lunar correction must be made, so that no further change will take place until 2200.

1900 is the first year of the cycle, and its epact would naturally be 0. But this year the solar year has no extra day, while the lunar year

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must receive its extra day as usual, and this day is always applied on January 1st. This will put the moon back a day relatively to the sun (for the solar year will be completed a day sooner than the lunar year), and its epact will be 29.

The epact being fixed, the 14th day of the Paschal Moon is found by adding months of 30 and 29 days alternately until a month is reached, the 14th day of which comes after the Equinox, on March 21st. It will be found that a new moon occurs on April 1st, and therefore April 14th is the 14th day of the moon, and as April 15th is a Sunday it will be Easter Day. This day happens to be the day of full moon, and the Act of Parliament lays down the rule that Easter shall be the Sunday following the *full* moon; but the Nicene rule has always been adhered to.

In the general tables for finding Easter given in the English Prayer-Book epacts are not made use of in them. Rules for their use are given in the Prayer-Book, and their construction is explained by Mr. Blaikie.

There seems to be a very general uncertainty as to when the 20th century begins. Those who regard the first day of this year as the beginning of a new century maintain that the numbers of the years mark the completion of each period of twelve months, just as degrees on a thermometer or the inches on a foot-rule are marked at the end of each degree or inch. According to them the date Jan. 10th, 1900, means that 1900 years and 10 days have elapsed since the beginning of the era. In the year immediately following the Nativity the months and days alone would give the date; on the completion of the year the figure 1 would be added, so that the first day of the next year would be Jan. 1st, 1. The other view, which we believe is more generally held, is that the number 1900 denotes the year, just as in a concert hall a number is attached to each row of seats, and as the seats in it all belong to that row, so all the months in 1900 belong to the 1900th year. This view is in accordance with popular usage, for we write Jan. 1st, 1900, whereas if 1900 marks the conclusion of the 19th century, we ought to write 1900, Jan. 1st. Again we say, for instance, that the battle of Waterloo was fought in the year 1815, whereas, if 1815 marks the end of the year, we cannot speak of a year 1815, or, at any rate, we ought to say that the battle was fought in the year 1816.

But we have received the Calendar from the old Calendar makers, and to actually solve the question we must ascertain how they applied the numbers. Is, according to their arrangement, the year 1900 the 1900th year? Now the Christian era was fixed by Dionysius Exiguus, and Mr. Blaikie says that the Birth of our Lord was supposed to have occurred "on the 25th December of the year of Rome 753," and that "the following January 1st, A.U.C. 754, became the starting-point of the era, and the year then begun is *known as* A.D. 1. . . . The year A.D. 1 was preceded by the year B.C. 1." The opponents of this view will admit that A.D. 1 was the first year, but will maintain that the number would not appear in the date of any event before the year was over. We must, then, search further. Take the cycles of 19 years. If 1900 years since the Birth of Christ were completed on the last day of last year,

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there have been 100 complete cycles since that event, and the first year of the first cycle was the year immediately after the Birth of Christ. But Dionysius states that the cycle was then already one year old. The Sunday Letters tell the same tale. Dionysius, calculating that the Birth of Christ was on a Saturday, found that the following Jan. 2nd was Sunday, so that the Sunday Letter of the year was B. If we now calculate the Sunday Letter of 1899, on the supposition that the number 1899 is applied to the whole year, we shall find it to be A, which is correct, for December 31st was Sunday.

Mr. Blaikie has been criticised for stating that "there being no year 0 each century of the Christian era is completed by a year finishing with the ciphers 00." Of course those who regard the number of year used in dates as indicating the number of years already passed, do not need this extra year to make up the 19 centuries. They regard 0 as merely marking the point from which we commence to count. But if we consider the date-number of the year as indicating the position of the year itself with regard to the Christian era, we could have completed 19 centuries at the end of last year only if the year immediately after the Birth of Christ had been denoted by 0, an asterisk, or some other sign—anything, indeed, which cannot be counted. A year 0 has in fact been used by astronomers in order to obtain the interval between two events, one of which occurred before Christ and the other after, by simply adding the numbers of the years. Let us suppose that one event occurred on April 1st, B.C. 15, and the other on April 1st, A.D. 15, and firstly, let us omit the year 0. Adding the numbers of the years together, we get 30 as the interval, which is wrong, for from April 1st, B.C. 15, to the end of the era the interval is $14\frac{3}{4}$ years, and the interval from the Birth of Christ to April 1st, A.D. 15, is $14\frac{1}{4}$ years, the total therefore being 29 years. But if the year in which Christ was born is called 0, the first event occurred in B.C. 14, and adding 14 and 15 we get 29, the correct interval. Thus the dates B.C. of chronologists and astronomers differ by unity.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meetings of Council.

At a meeting held on November 30th, the following ladies and gentlemen were elected Members of the Society :—

Annandale, Miss F. T.
Hamilton, Miss Grace D.
Kerr, Miss J. Kinnear.
Chisholm, A. W.
Cran, John.
Hart, Dr. D. Berry.
Jack, T. Chater.
Menelaws, Wm.
Rorie, T. H. B.
Scott, Wm.
Thomson, T. S.
Tillie, Wm. J.
Wright, Jas. M.

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Mr. J. R. Reid, C.I.E., was, on the motion of Mr. Wenley, appointed Honorary Treasurer in the room of Mr. J. Cockburn, who resigns, and Mr. Cockburn was appointed a Member of Council.

It was resolved to confer the Diploma of Fellowship on Lord Charles Beresford, as a distinguished traveller; and the Diploma was also granted to Mr. W. S. Pillans, who had applied for it in the ordinary course.

Mr. George Sandeman was appointed Editor from January 1st, 1900, in the room of Mr. W. A. Taylor, who resigns.

Another meeting of Council was held on December 15th, when the following were elected Members of the Society:—

Inglis, Mrs. W.
Johnston, Miss H. M.
Barry, Lieut.-Colonel, I.M.S.
Conquergood, Frank.
Haig, H. A. de Courcy.
MacLaren, T. Shaw.
Meiklejohn, Wm.

With those elected on November 30th, the total number is 20.

The names of nine members, whose subscriptions are in arrear, were removed from the roll.

Lectures delivered in December.

On December 14th, Mr. O. H. Howarth lectured in Edinburgh on "The Cordillera of Mexico and its Inhabitants." Sir John Murray, K.C.B., President of the Society, took the Chair.

Mr. J. Young Simpson, M.A., B.Sc., addressed the Glasgow Branch on December 11th, his subject being "The New Siberia." Sir J. N. Cuthbertson presided.

On the following evening Mr. Simpson lectured to the Dundee Branch, Mr. I. J. Weinberg presiding. On the motion of the Rev. Dr. Colin Campbell, a vote of thanks was awarded to Mr. Simpson.

Lectures in January.

A meeting will be held in Edinburgh on January 8th, when Mr. J. B. Tyrrell, late of the Canadian Geological Survey, will describe the physical geography of the Yukon basin.

At a second meeting, to be held on January 18th, Mr. W. Barbrooke Grubb will deliver a lecture on the Chaco and its people.

At Glasgow there will be a meeting on January 15th. Mr. Grubb will be the lecturer.

Mr. Tyrrell will lecture at Aberdeen on January 10th.

Mr. Tyrrell will lecture also at Dundee on January 9th.

GEOGRAPHICAL NOTES.

By The Acting Editor.

EUROPE.

The Population and Geology of Sardinia.—Signor A. Cossu, who has already worked out the distribution of the population of his native island in relation to distance from the coast (see vol. xiv. p. 371), has now measured with a planimeter

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on the geological map of Italy on the scale of 1 : 1,000,000, the various surface formations, the following results :—

Surface Formation.	Area in Square Miles.	Population in 1881.	Number of Persons per Square Mile.
Alluvium . . .	495	36,201	73
Diluvium . . .	456	42,495	93
Miocene . . .	934	239,663	257
Eocene . . .	148	7764	52
Jura and Lias . .	110	12,694	115
Silurian and Cambrian	1233	49,914	40
Crystalline Rocks .	860	55,913	65
Granite and Syenite .	2813	112,643	40
Basalt and Basaltic Lava . . .	549	45,690	83
Trachyte, Andesite, and Tuff . . .	1020	79,130	78
Other Formations .	407		
Total . .	9025	682,107	76

Thus almost a third of the population lives on the Miocene formation, which occupies little more than one-tenth of the total area. But Signor Cossu believes that this is due to its situation even more than to its natural advantages for cultivation. The Miocene lies in strips at a certain distance from the coast almost all round the island, never rising higher than about 1600 feet above sea-level, and everywhere avoiding the unhealthy coastal region. Moreover, the two principal towns of the island, Sassari and Cagliari are built on it.—*Globus*, Bd. lxxvi. No. 14.

The Population of Spain.—A census has been taken in Spain every ten years since 1857. The provisional results of the census on December 31st, 1897, have lately been published. The total population in that year was 18,089,500, being an increase of 523,868, or nearly per 3 cent., since 1887. The increase between 1877 and 1887 was much larger, namely 915,901; and the reason given, that in 1897 the armies sent to the Antilles and the Philippines (estimated at more than 220,000) were not included in the census, is not adequate. The annual increase during the past 110 years, since the first Spanish census of 1787, has been only 0·67 per cent. This is not only very small in itself, but is much less than the increase in the other States of Europe, France included.

On the whole, the peripheral districts are the more densely populated; but in respect of increase of population, at least, Galicia takes the last place, and may be grouped with the Meseta. The difference in density at the beginning and end of the decade was 15½ per square mile in Galicia and 10 on the Meseta, while for the other districts of the periphery (excluding the kingdom of Grenada) it ranges from 18 to 54. This contrast is accentuated in the figures for the 110-year period. The greatest increase is registered in Catalonia, Valencia, and Vascongadas, and here, as in the rest of Europe, it is due chiefly to the development of commerce and industry. Vascongadas is one of the most productive mineral regions of the peninsula, and is the great land highway of commerce between Iberia and the rest of Europe.

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Catalonia and Valencia are also commercial districts, but thrive principally, the former on cotton-spinning, and the latter on mining.

The kingdom of Spain is the creation of the Castilians, and the estimates of 1580 indicate that the Meseta, Galicia, and the Asturias then contained two-thirds of the total population of the kingdom. Slowly this proportion has diminished, until now the population of the above regions only slightly exceeds that of the peripheral districts. As the political representation is based chiefly on the census, the preponderance of the population of the peripheral districts over the agricultural and pastoral population of Castille may lead to important consequences.

On December 31st, 1897, Spain contained sixty-one communes of over 20,000 inhabitants each, as against twenty-nine in 1857. Of the thirty-two towns thus added, only four (Vittoria, Salamanca, Toledo, and Lerida) are situated in the interior, the others being one-third in northern Spain and two-thirds on the Mediterranean side. Among the latter are the two new cities, Murcia and Malaga, with more than 100,000 inhabitants each. Thus, as in other European countries, the population gravitates to the commercial and industrial centres. During the past forty years the inhabitants of Madrid have increased by 84 per cent., and those of Barcelona by 178 per cent. In 1857 the urban population, 1,646,203, constituted 10·9 per cent. of the total, whereas in 1897 it had risen to 3,648,338, or 20·5 per cent. of the total.

Dr. Fr. M. Pasanisi shows the various details of the census in tables in the *Boll. della Soc. Geogr. Italiana*, November 1899.

ASIA.

The Survey of India.—Triangulation was executed in the year 1897-98 in Baluchistan to carry the Makran longitudinal series westwards, but was interrupted by the serious disturbance that took place there. The party were fortunate in escaping with their lives. Topographical survey was carried over 15,109 square miles in Burma, Sind, the Lushai hills, the Himalayas, and Baluchistan, and 9976 square miles on the eastern and western frontiers were geographically surveyed. Tidal observations have been continued, as usual, at thirteen stations in India, Burma, the Persian Gulf, the Andaman Islands, and the Red Sea. A revision of the triangulation of the Khasi and Garo hills was made to ascertain what displacements have been caused by the earthquake of June 1897. Horizontal and vertical observations were taken at thirteen stations, scattered over an area of 1020 square miles. The results show that all the stations lie within the area affected by the earthquake, so that it is impossible to say how much any station has been displaced in comparison with the area outside the range of the earthquake. The average horizontal displacement appears to be about 7 feet, while the changes in height vary from a subsidence of 4·3 feet to an upheaval of 24 feet; but these can only be considered as relative changes. The general effect seems to be that the area has been widened and raised.

Some account of the country to the north-west of Bhamo is given by Major Longe who accompanied the Burma-China Boundary Commission. Parties were sent on in advance to continue the Irrawaddy triangulation series from Katha, and the Shan States secondary series from the Salwin river, to the vicinity of the frontier. The country to which the operations of this section of the Commission was confined lies between the rivers Taping on the north and Namwan on the south. These flow parallel to each other in a south-westerly direction at an average distance of 30 miles apart. The former is far the larger, and is a deep, rapid stream, flowing between steep forest-clad hills, and forming a serious obstacle

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to travellers. The latter flows gently for a considerable distance through the fertile valley of Mongwan, and passing into the hills at the south-west makes an abrupt turn at Namkhai to join the Shweli. Between these three rivers run two high ranges of hills, that between the Taping and Namwan being by far the grandest. The hills gradually diminish in height from the Namkhai Pum (8687 feet), immediately over the Taping on the north-east, to the peaks on the spurs overlooking the Irrawaddy valley, which run to about 4000 feet. The hills are steep and rugged, the valleys deep, and except in the case of the Kulong *kha* little land is actually under cultivation. The clearing is absolute, and an enormous area is denuded of forest and covered with dense *kaing* grass and small jungle. Water is abundant. There is nothing remarkable about the smaller streams, except, perhaps, the Kulong *kha*, the bed of which is very level for some miles at an altitude of about 4400 feet, and then falls rapidly in torrents to the Taping. Though there was abundance of water in these streams and many fine pools, not a fish was seen more than an inch or so in length. Game was not abundant.—*Report of the Operations of the Survey Department*, 1897-98.

The Danau Lake in Celebes.—When the travellers P. and F. Sarasin were exploring the northern peninsula and Celebes they heard that the Poigar river, which flows through the small Mokobang lakes, originated in a much larger lake called Danau or Dano (see vol. xii. p. 338). Lately a mining engineer, M. Kopenberg, has succeeded in reaching this lake. After traversing the uninhabited tract to the right of the Ranoiapo, he started on May 30th from the abandoned tobacco plantation Karoa, and on June 1st came to the edge of the plateau, 3000 to 3300 feet above sea-level, and the next day to the river Poigar, where the brothers Sarasin crossed it. A troublesome journey of two days through dense forest then brought him to the lake. The sheet of water, relieved by a small picturesque island, made a striking impression after the toil through the gloomy forest. On the west, south, and east it is shut in by mountains. On the west they present a group of high summits, behind which a bare white wall appears, apparently the inner margin of a crater. North-eastwards the girdle of mountains ends in a lofty dome, behind which rises a still higher mountain mass. The volcanic elevations on the west are, as far as Heer Kopenberg could ascertain from the natives, the G. Ambang, and a mountain farther to the north, also volcanic in form, the G. Modoinding. Certainly these are the mountains marked on the Sarasins' map as an unexplored volcanic group; but the name Ambang appears in quite a different place.

The length of the Danau lake, from north-west to south-east, was estimated at fully three miles, and its breadth at one to one and a quarter, and the area is therefore less than a fourth of that of the Tondano lake. The immediate neighbourhood is quite deserted, and indeed the plateau of the Poigar as a whole seems to be only occasionally visited by people from Mongondo. The surface of the lake stands at a height of 3440 feet above sea-level, and the highest of the surrounding summits may safely be estimated at over 6500 feet. The chief feeder of the lake is the Maäjat, on the south-west, which flows down from G. Ambang.—*Tijdschrift van het K. Nederl. Aardrijkskundig Genootschap*, Deel xvi. No. 5.

OCEANS.

The Deep Sea Expedition in the Malay Archipelago.—On March 1st, 1899, the *Siboga* expedition, under Professor Max Weber, left Soerabaia and, keeping to the south of Madoera, came to an anchor at Djankar, on the north coast of Java, for the purpose of examining the coast and dredging. Then, on March 11th, the reef

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at Badjoelmati (east coast of Java) was visited, and the course set for the Kangean islands. On the way, depths of from 164 to 383 fathoms were sounded, and many specimens of fish and crustaceæ obtained. The deep-sea fauna was found as high as 165 fathoms, and this was explained by the fact that the cold bottom-water temperature of 44½° F. prevailed up to 330 fathoms, while 48° was found at 220 fathoms, and 50° at 190, the temperature at the surface being 83.3°. Owing to the difference of temperature between the bottom and surface, nearly all the specimens came up dead. On the way to Ampenan, on the west coast of Lombok, depths of 550 fathoms were sounded, and organisms collected from water at a temperature of 41·4°.

The origin of the cold bottom water in the Bali sea was then inquired into. Previous soundings had given cause for believing that this water might flow out of the Indian Ocean through the Lombok strait. But, while a considerable depth was found almost up to the island of Penida, a series of thirteen soundings on the south side of the strait revealed the existence of a threshold extending from the south-western point of Lombok to Penida, and thence by the islands Tjeningan and Lembongan to Bali; the greatest depth found on it was only 170 fathoms, while the temperature records showed that no water colder than 54° could pass over it. The Kangean islands and Bali stand upon a ridge, which rapidly slopes southwards to 550 fathoms, and then gradually to 710 fathoms, and 550 fathoms are found nearly up to the northern side of Penida, where the threshold lies. Bad weather interrupted the operations, but it was proved that Lembongan and Tjeningan are connected by a fordable shallow, and in the strait between Tjeningan and Penida, named after Captain Tydeman of the *Siboga*, a depth of 105 fathoms was sounded. Wallace's line is often drawn through the Lombok strait, but the discovery of shallow water between Bali and Lombok tells against this view.

The Allas strait being of small depth, the next question to be solved was whether the oceanic water comes westwards from the Flores sea; and therefore the *Siboga*, passing through the Allas strait to the Paternoster and the Postillon islands, made thence southwards to Bima in Soembawa. A deep connection was found to exist between the Bali and Flores seas, with a bottom current from the east and a weak surface stream of warm water from the west. The Paternoster islands, like the Postillon, stand on a plateau, and it may be inferred that a submarine ridge passes beneath them from the Kangean islands to the south-western peninsula of Celebes.

The German *Gazelle* expedition found in the basin between the islands Flores, Soemba, Savoe, and Timor (called by Professor Weber the Savoe sea) a bottom temperature of only 37½° to 39°—much lower than in the Bali or Flores seas. The *Siboga* soundings show that this water cannot enter from the west side. Rottok, who superintended the soundings of the German expedition, inferred the existence of a threshold between Soemba and Savoe of about 1090 fathoms, over which water at 37·8° could flow and pass through the Ombaai strait to the Flores and Bali seas and penetrate into the Banda sea. The *Siboga* expedition, however, found depths of only 800 fathoms between Soemba and Savoe, and as the water is still shallower between Savoe and Rotti and in the Rotti strait, this theory of the circulation falls to the ground, and the only route by which the cold water can find its way into the Flores sea is through the Banda sea, the Savoe sea receiving its cold water *from* the Ombaai strait. It remains to be ascertained by what channel the cold water reaches the Banda sea. From Roesa Linguette, a small island north of Timor, the vessel steered along the Angelika bank and the islands of Kalaoe-Toea, Madoe, Boneratoe, and Kalao, and a deep entrance to the Flores sea of nearly 1400 fathoms

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was discovered between Roesa Linguette and Kalaoe-Toea. Then the *Siboga* crossed the Flores sea to Salayer, and having sounded 1700 fathoms at a distance of eleven miles from the land, proceeded to Soerabaia to refit.

On resuming work in July, the expedition began by examining the bank on which the Spermonde archipelago lies and the Borneo bank with the Little Paternosters. 1110 fathoms was sounded in the Makassar strait, which forms a deep basin between the two banks and receives the rivers of East Borneo and Celebes. This basin is not suited for animal life, and little but mud was dredged up. The Borneo bank, lying to the north of 3° 30′ S. lat., rises steeply from the Makassar strait and slopes gently towards the coast of Borneo. In the Celebes sea the greatest depth sounded was 2173 fathoms.

The report in the *Tijdschrift van het K. Nederlandsch Aardrijkskundig Genootschap*, Deel xvi. No. 5, will be continued.

The Vessel for the German Antarctic Expedition.—This vessel, according to the specification of the construction committee, is to be a wooden sailing vessel with a screw, electrical lighting and steam-heating apparatus and a condenser capable of supplying about 260 gallons of fresh water in the twenty-four hours. It must be able to offer great resistance to the impact of ice, and to contain thirty to thirty-two men with all requisite supplies for three years. Its speed, when fully fitted up and sunk to the stipulated depth, must be seven knots an hour, and its powers will be tested by time and distance trials. The contractor deposits £1000 as caution-money for the thoroughness of his work and guarantees its soundness for twelve months. A delay in handing over the vessel will entail a fine of £5 a day and an excess of draught will involve a compensation of £50. The vessel will be manned by the leader of the expedition, four scientific members, a captain, first officer, two ship's officers, an engineer, ten sailors, six machinists and stokers, a cook and a steward—twenty-eight persons. The draught, when the vessel is fully equipped and laden shall, if possible, not exceed 16½ feet, and the length between perpendiculars shall be 155 feet. The cargo and apparatus, including provisions for three years, petroleum boat, instruments, captive balloon, station-house, the men and their effects, etc., will weigh 721 tons. The boats will be to a certain extent of the whale-boat type. The interior of the vessel's hold will be of the best seasoned oak. All the iron work is to be coated with zinc, and copper will be used as much as possible in order that the magnetic observations may be more easily taken. The whole vessel will receive three coats of oil paint inside and out, and the sides will be coloured grey down to the water-line, below which tar or a patent colour will be used. It will be rigged as a three-masted schooner with top-sails, and the sails will be large enough to answer all requirements without the aid of steam. On the bow and poop small refractors lighted by acetylene gas will probably be erected. All the cabins will be warmed by steam, so that the temperature will be raised to 50° F. when the temperature outside falls to −20°. Electric lighting will be used all over the ship.—*Verh. der Gesell. für Erdkunde zu Berlin*, No. 7.

MISCELLANEOUS.

The **White Pass and Yukon Railway** was opened for traffic at the end of July. Dawson may now be reached from Victoria or Vancouver in nine days.

During the hurricane that devastated **Porto Rico** in August last, the velocity of the wind varied from 36 to 141 miles per hour. The highest velocity previously recorded in this region was 80 miles an hour. The barometer fell to 28·6 inches, the lowest record in the Antilles on the Atlantic side.—*Ciel et Terre*, Nov. 16th.

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Mr. A. H. Whitcher, Secretary of the Geographic Board of Canada, informs us that the name of the man who discovered Lake Lebarge or Labarge, as it is frequently spelled, was **Laberge**. This spelling has been proved by registers and other indisputable evidence, and has therefore been adopted by the Board for the name of the lake. The Board intends to conform to the decisions of the United States Board relative to place-names in that country, and anticipates that the United States Board will adopt the Canadian forms.

On the **Map of Kamchatka** which accompanies Mr. Barrett-Hamilton's paper (vol. xv. pp. 225-256) the heights of Kliuchevskaia and its neighbours are those marked on the Admiralty Chart No. 2388 (corrected to August 1897). These heights were taken from the Russian charts. Dr. Guillemard, however, has still full confidence in the accuracy of the heights given in his *Cruise of the "Marchesa,"* most of which were determined by Captain Powell, R.N., a most expert and careful observer. Several series of observations were made, and the results in the case of the chief peak came out remarkably close—to within a few feet—the mean of all the observations of it being taken as its height. The heights are as follows: —Kliuchevskaia, 16,988 feet; Krestovskaia (Ushkovska), 12,500; Ushkinska (Kojerevska), 15,400; and Tolbacha, 11,700. The number of observations of the three last being fewer, the heights are given as fairly approximate only. Mounts Herbert Stewart and Gordon are probably about 8000 feet high, but they were not measured. The names in brackets are from *The Cruise of the "Marchesa"*; but Dr. Guillemard is inclined to consider the others to be the correct appellations. Mr. Barrett-Hamilton quotes Dr. Guillemard's figures in his article, and is not responsible for the insertion of the heights of the Admiralty chart on the map.

NEW BOOKS.

The Highest Andes. A Record of the first Ascent of Aconcagua and Tupungato in Argentina and the Exploration of the surrounding Valleys. By E. A. FITZGERALD. London: Methuen and Co., 1899. Pp. 390. *Price* 30*s. net.*

This book is the outcome of seven months' work in the Andes of Argentina by Mr. FitzGerald and his colleagues, Messrs. Stuart Vines, Arthur Lightbody, and Philip Gosse. The expedition had two objects: 1st, The triangulation of the country immediately surrounding the peak of Aconcagua, America's highest mountain; and 2nd, The climbing of that hitherto unscaled peak which rises 23,082 feet above the sea.

Mr. FitzGerald's expedition reached the Andes in December 1896 and at once began attempts on Aconcagua. Fortunately Mr. FitzGerald's famous Swiss guide, Mattias Zurbriggen, accompanied him, and although Mr. FitzGerald was compelled by desperate sickness to turn back at a height of about 22,000 feet, Zurbriggen struggled on and reached the summit. Thus was Aconcagua conquered for the first time in history in January 1897. Mr. FitzGerald and Mr. Vines returned to the assault that same month, but were beaten back by snow and cold, and several days elapsed before they recovered. However, Mr. Vines succeeded in making the second ascent, and details in two chapters how he and the guide Lanti Nicola accomplished it in February 1897. Tupungato (21,550 feet) was next attacked, and after three attempts Mr. Vines and Zurbriggen succeeded in scaling it in April 1897.

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For many days afterwards the expedition was engaged in the work of triangulation, and "took very elaborate pains to get their measurements absolutely correct." In addition to this, they made during their tour valuable collections of specimens of the rocks, fossils, natural history and plants of those parts of the Andes which they traversed, and notes on these by specialists are appended to the volume, which is illustrated by an admirable series of photogravures and several maps.

As a thrilling record of mountaineering and a scientific contribution to our knowledge of the highest Andes, this work will be welcomed and appreciated by every class of reader. For those who wish to know the sensations experienced by Mr. FitzGerald at a height of 22,000 feet, and which compelled him most unwillingly to retrace his steps when victory was within sight, for he was within a thousand feet of the top, we subjoin this paragraph: "I got up and tried once more to go on, but I was only able to advance from two to three steps at a time, and then I had to stop, panting for breath, my struggles alternating with violent fits of nausea. At times I would fall down, and each time had greater difficulty in rising; black specks swam across my sight; I was like one walking in a dream, so dizzy and sick that the whole mountain seemed whirling round with me."

In Dwarf Land and Cannibal Country. By A. B. Lloyd. London: T. Fisher Unwin, 1899. *Price* 21*s. net.*

To those of our readers who heard Mr. Lloyd lecture in April last on the land of the Pygmies this book will need no recommendation. To tell the truth, however, its name is rather misleading. It contains 385 pages, and it is not till page 297 that we get to Dwarf Land, and some 30 pages are all that are given to what is the most important part of Mr. Lloyd's work, *i.e.* the land in which he had the opportunity of original exploration and research. We hasten to add that the rest of the book is very interesting, and well repays a perusal. His route was from Zanzibar through German East Africa and Lake Victoria Nyanza to Uganda; and we have a graphic and vigorous description of his lonely and dangerous march through the forest. He went in the capacity of a lay missionary attached to the Church Missionary Society, and his special sphere of work was in Toro, whither he proceeded after fifteen months of apprenticeship in Uganda. Toro lies in the extreme west of the Uganda Protectorate, between Lakes Albert Edward and Albert, at the foot of the famous Ruwenzori, which towers some 18,000 feet above sea-level. His work, however, at Kabarole, the capital of Toro, was soon interrupted by the Soudanese rebellion, in the suppression of which Mr. Lloyd, apparently not much against his will, had to take a not unimportant part. His account of the rebellion is most graphic and interesting. His health, however, broke down, and Bishop Tucker ordered him home. After consulting a Belgian officer, he decided to return through the land of the pygmies and down the Congo, thereby passing through a part of the primeval forest of Africa through which no European had as yet ventured. For a too brief description of the wonders of the forest we must refer our readers to the book itself. It is a paradise for the zoologist, the entomologist, the ornithologist, the sportsman, and the adventurous. It was some days before Mr. Lloyd became aware of the presence of pygmies, although, as a matter of fact, they had been watching his movements and accompanying his camp from the time he had entered their country. However, he soon succeeded in establishing most friendly relations with the little people, but they would not take him to their houses or villages. Still, he came upon some in the course of his marches, and was able to gather together much valuable information regarding their habits, customs, beliefs, and religion. The men were about four

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ACONCAGUA FROM HORCONES VALLEY.

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TUPUNGATO FROM THE EAST.

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feet in height, but with "a powerfulness about their build that is not often seen in African races. Broad-chested, with muscles finely developed, short, thick neck, and small bullet head, the lower limbs were strong and massive to a degree. The chest was covered with black curly hair, and most of the men wore thick black beards. Each carried either bow and quiver of arrows or short throwing spears. Round their arms they wore iron rings, and some of them had these round their necks also." The women "were very comely little creatures, and most attractive, with very light skins, lighter even than the men, being of a light tan colour; the usual flat nose and thick lips of the Negro, and black curly hair; but their eyes were of singular beauty, so bright and quick and restless they were, that not for a second did they seem to fix their gaze on anything. They were smaller than the men." After leaving Dwarf Land Mr. Lloyd marched from Avakubi to Basoko, passing through the territory of the Bangwas, a notorious cannibal tribe, for whom, however, from their "great depth of character and superiority" he anticipates a brighter future, when the influences of Christianity and civilisation shall have been brought to bear upon them. From Basoko he proceeded to the coast, and thence to England. Mr. Lloyd tells us that owing to the unfortunate upsetting of a canoe, many of his best plates were destroyed; nevertheless his book is well illustrated, and he has added some useful maps. We cordially recommend this book to all our readers.

The Redemption of Egypt. By W. Basil Worsfold, M.A. London: George Allen, 1899. Pp. 333. *Price 25s. net.*

This is one of the most beautiful books on Modern Egypt which has ever been published, and is a worthy issue by a house associated with the name of Ruskin. The delicate pencil drawings it contains would delight his eyes, whilst the valuable history and descriptions which Mr. Worsfold presents after a visit to Egypt during the winter of 1898-99, and the facts he has gleaned by personal observation and from the best authorities in Cairo, will be appreciated by every reader. Altogether it is a masterly, as it is also a most artistic, production, and reflects great credit on both author and publisher. Mr. Worsfold has caught the glamour, as he has also grasped the history, of the land which Pharaohs, Romans, Moslems, and Britons have successively ruled.

The book contains not merely statistical chapters dealing with the cotton industry, education, law and order, the Barrage and irrigation service, railways, sugar, and finance, but descriptions of Alexandria, Cairo, the Pyramids, Luxor, and Assuan, and a particularly valuable and original chapter on "The mosques, as illustrating the development of Arabian art in Egypt." As a specimen of the author's descriptive style, we may quote his account of what he saw whilst standing on the Windmill Hill, situated between the tombs of the Khalifs and the eastern limit of Cairo:—

"But it was on the south-west horizon that the marvels gathered. Beyond the violet domes of Mohammed Ali's mosque and the rising towers and bastions of Saladin's stronghold, two sharp angles showed above the low clouds that wreathed the horizon. They were—yes, they could be nothing else than—the Pyramids of Cheops and Chephren. As the sun fell—a crimson globe—the purple clouds gathered in ampler masses, and spread a veil over desert, hill, palm-trees, and city; but above the veil two blue triangles remained beckoning us to Memphis, as they had beckoned the Syrian merchant on his camel five thousand years ago." The allusion is of course to Abraham and the pyramids of Sakkâra.

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Alaska and the Klondike. By ANGELO HEILPRIN, F.R.G.S., F.G.S.A. London: C. Arthur Pearson, Limited, 1899. Pp. 315. *Price 7s. 6d.*

The books published upon the modern Eldorado must already amount to a library of themselves, and among them this work from the able and impartial pen of the Professor of Geology at the Academy of Natural Science at Philadelphia is entitled to rank high. Impartiality and accuracy are what the Professor has aimed at, and certainly his account of Klondike gives us the impression that it is much more trustworthy and correct than many others which we have seen. He rode over the famous Skaguay Pass on the 30th July of last year, finding neither wind, nor snow, nor ice on the mountain declivities, and his only trouble was a stiff and lame horse. He left Dawson as late as the 20th September, and accomplished the return journey with no mishaps, except petty delays caused by his steamer occasionally running aground. Evidently the road to Klondike has been much improved within the last year or so. Under ordinary circumstances the journey from Seattle or Victoria to Dawson should now be made in ten days or even in less. Now that the railway to Bennett lake is completed, the route over the dreaded Chilkoot Pass will certainly be abandoned, and the dangers and terrors of the journey to Klondike will soon be things of the past. We have all read in accounts of Klondike of the clouds of malarious mosquitoes which make life a burden there during the summer months. The Professor does not deny their existence, but he says, "During my entire stay at Dawson I saw not a single mosquito, although doubtless some were present about town; and I am assured that even in what might be considered the true mosquito season, May, June, and July, there are not enough of the insects to call for even passing notice. . . . On the other hand, there can be no question as to the reality of the mosquito pest in some quarters," and he suggests the trying of the experiment of breeding dragon flies as a means of their extermination.

Much the most valuable parts of the Professor's book are his hints to intending emigrants as to their choice of route, selection of outfit, and choice of ground where to prospect and try for gold; and his last chapter containing the laws governing placer-mining in the Yukon district should be carefully studied and digested by all who decide to try their fortunes in Klondike. As to the future of Eldorado, the Professor, who studied the region with the patience and skill of an expert geologist, does not hesitate to say, "Many more streams than are now known to be auriferous will be discovered to be gold-bearing, and this applies equally to such as are entirely unprospected and to others which have been declared barren through insufficient or deficient prospecting. . . . No limit can be told at this time to the heights at which gold may be found and worked with profit. . . . It seems probable that the Klondike gold region is merely a fractional part of a discontinuously continuous auriferous tract that extends in a westerly course into the heart of Alaska and southward into British Columbia." If these conclusions are verified, there can be but little doubt that the gold-fields of Alaska and British Columbia will cause profound changes in the distribution of population, wealth, and commerce in the course of the twentieth century. We should add that the book is illustrated with many beautiful photographs, and is equipped with an excellent map.

Tunisia and the Modern Barbary Pirates. By HERBERT VIVIAN, M.A., author of *Servia, The Poor Man's Paradise*, etc. etc. Illustrated with Photographs and a Map. London: C. Arthur Pearson, Limited, 1899. Pp. xvi + 341. *Price 15s.*

The author of this book has a good conceit of himself. He begins it by telling

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us that the authorities on Tunisia are not worth enumerating (they are in fact not inconsiderable in number, and of at least three or four nationalities); and that the French among them are prejudiced and stupid. Having spent some time in the Regency he has written this book, wherewith, he would have us acknowledge, he has covered new ground, and whereby he is satisfied that he has served three purposes. These are to provide an indispensable companion to the traveller, to expose Lord Salisbury, and to pay a tribute to the Arabs. The author is prepared to be deemed a pessimist. He airily asserts that he is at the least unprejudiced.

But a great deal of the information about the country and peoples and history of Tunis which is contained in the book is already on record in the authorities which "are not worth enumerating"; and the principal "new" feature in the book is the exposition of Lord Salisbury's conduct in respect to Tunis and of the French system of administration there.

The administration, the author says, is as rotten as that of the French Republic. He does not deny that Tunisia has prospered in many ways under the French. But the official picture of progress is—naturally enough, surely—too highly coloured, as the author endeavours to exemplify by a certain number of incidents, some noticed by him, some attributed to other persons. These merely go to show that the administration is not so progressive or enlightened as that in the neighbouring country of Egypt. That was not to be expected. But as far as we have observed, the author has little except suspicion and contempt for all things, material or moral, done or tried in Tunisia by the French, who are, with doubtful taste, dubbed by him "The Modern Barbary Pirates." Further, he denounces Lord Salisbury "with his genius for evasion," as having been accessory before the deed to the initial act of piracy, and as responsible for its consequences. He regrets, as we understand his argument, that the British have not taken the place of the French in Tunisia. He anticipates, however, the destruction of the existing arrangements for its government, and he would then have Great Britain assert and vindicate her supposed claims.

Now, the French occupation of Tunisia took place in 1881-82, when Mr. Gladstone was in power in England; and it was Mr. Gladstone's administration which, in 1884, by assenting to the abolition of the capitulations and the establishment of French law courts, practically accepted French rule as an accomplished fact. The author avers that at Berlin, in 1878, Lord Salisbury assented to France's designs: agreed that she should take possession of Tunisia "as a sop in return for Cyprus." If "spheres of influence" in the Mediterranean region were then a subject of diplomatic compromise, it would have been a not unnatural arrangement to assign Tunisia to the French sphere; but Great Britain could not hope to attach everything. But what evidence is there of that, much less of Lord Salisbury having assented beforehand, on behalf of Great Britain, to an unscrupulous piece of chicane and aggression (as the author and other Englishmen, as well as some Frenchmen, think), perpetrated in 1881? Neither in 1881 nor later was it a matter of duty or expedient for the English Government to attempt to assume, either jointly or solely, and in addition to Egypt, another North African protectorate—one wherein, as consular reports show, British interests, trade and other, are comparatively insignificant. The author evidently thinks that France is neither enriched nor strengthened (even with a fortified Bizerta) by her possession of Tunisia. Possibly she is not. But that the French will lose their hold upon it and be replaced by the English is surely a forecast suggested more by dislike of the French than love of the English.

According to this book the Arabs who ruled in Tunisia from the seventh to the sixteenth century A.D. belonged to the noblest portion of the human race.

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The so-called Arabs now found in Tunisia seem to be a very mongrel people indeed. But, for our author, they are "the last survivors of that grand mediæval race which has bequeathed to us whatever civilisation we may possess, and which shall yet, *inshallah*, live to restore a portion of its departed glories." "Just," he also remarks, "as you have only to set eyes upon a Yankee to know him for an impudent vulgarian, so the first sight of an Arab suffices to convince you that he possesses every instinct of a gentleman." We have here a curious reading of the past, and a still more curious anticipation of the future. The diagnosis of Arab character is, we should also say, founded more upon superficial observation of the Arab's personal manner and bearing than upon an intimate experience of his *morale*.

Overlooking peculiarities of opinion (we shall not call them prejudices) like these, however, we may say that the author in describing native life and scenes in Tunisia is a bright and amusing writer. Sympathising with the Arabs as he does, he naturally devotes a good deal of space to Mohammedan manners, customs, beliefs, and superstitions. These do not greatly differ from those prevailing in other Moslem countries farther east. An interesting—we may hope not wholly unprejudiced—account is given of the Tunisian Jews, and of other sections of the population, whilst a popularly written chapter deals with the employments of the people—agricultural (mainly) and industrial. The author tells us that he does not love tourists. It is therefore fair to assume that in the pages allotted to a description of his itinerary he has set down nothing merely for the purpose of beguiling tourists to Tunisia. Yet much of his narrative is entertaining; and if the visitor does not find the book "indispensable" (as the author flatters himself), it will at least serve more or less as a lively guide complementary to Murray and Baedeker. The bazaars and inhabitants of Tunisia still preserve the forms, colours, and air and mien of the Orient; the country contains many fine antiquarian remains, as yet imperfectly explored. It therefore possesses features attractive to travellers of various types, who may read this book with some advantage. There is no reader who will fail to find delight in the charming photographic pictures with which the book is illustrated.

In a Corner of Asia. By HUGH CLIFFORD. ("The Over-Seas Library.") London: T. Fisher Unwin, 1899. Pp. 279. *Price* 1*s.* 6*d.*

Those of our readers who have already perused his *In Court and Kampong* and *Studies in Brown Humanity* will be delighted to receive at the hands of Mr. Clifford a third series of Malay stories, which he has entitled *In a Corner of Asia*. His descriptions of the actual life of both natives and Europeans in that little-known part of the Queen's dominions are obviously so true to nature, and his power of the pen is so great, that we rise from a perusal of these tales with the feeling that we know both the people and the country. Each one of the tales has a power and grace of its own, but if we had to select one as more interesting and exciting than the others it would be the "Death March of Kûlop Sûmbang." For tender sympathy and genuine pathos the story of a "Daughter of the Muhammadans" must take a place in the same rank as the masterpieces of Rudyard Kipling, and indeed it is hardly too much to say that Mr. Clifford is doing for the Malay Peninsula what Kipling did in his earlier tales for India. His long experience and exceptional opportunities in Perak have been utilised to the full. His style is sharp and incisive, and without any apparent effort he holds the attention of his readers from the first to the last line of each story. Altogether his works furnish us with a revelation of Chinese and Malay life and character which is quite unrivalled.

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Admiral Phillip. By LOUIS BECKE and WALTER JEFFERY. ("The Builders of Greater Britain" Series.) London: T. Fisher Unwin, 1899. Pp. xx + 336. *Price 5s.*

In a previous number of this *Magazine* we noticed Messrs. Becke and Jeffery's *Naval Pioneers of Australia.* In the present volume the same authors expand the story of Captain Phillip, who may justly be considered a Builder of Greater Britain, as he founded the colony of New South Wales in 1787. A more hopeless task than that committed to the gallant sailor could hardly be imagined, for he was ordered to found a colony on an unknown coast with some hundreds of convicts who might fairly be described as the scum of England. The courage, prudence, and wisdom of Phillip were repeatedly tested on the voyage, and still more so on his arrival at Botany Bay. He had orders to land and settle there, but a brief survey of the tract convinced him that it was unsuitable for the purpose, so disregarding the orders of Lord Sydney he proceeded to search for a good site. His selection of Port Jackson, now the magnificent port and city of Sydney, has received the approval of posterity, and even if it stood alone, would secure for him the gratitude of Australia and the mother country. The period of his rule in New South Wales was a short one, *i.e.* only six years, during which he had to combat the difficulties of starting a colony in an unknown and hostile savage territory, with the most unpromising materials, and with but the minimum assistance from the Government at home. The story of his success in this unprecedented task is told with considerable power, and is full of historic interest. Phillip had but little leisure in which to explore or clear up points of geographical interest or research, but he made some short expeditions inland, discovered the Hawkesbury and Nepean rivers, and reached the base of the Blue mountains. As set before us in this volume he is a man of great self-reliance, shirking no responsibility, gentle, kindly, and humane in his dealings with the natives, but firm, and when occasion required it very severe, to the convicts of whom he had charge, yet withal modest in his estimation of his own services; a strong and amiable character, one which wholly justified the selection of Sir Joseph Banks and Lord Sydney. This book deserves a cordial welcome here as well as in Australia.

Von Kap zum Nil. Reise-Erinnerungen aus Süd-, Ost- und Nordafrika. With Illustrations. By Dr. KARL DOVE. 2nd edition. Berlin: Allgemeiner Verein für Deutsche Litteratur, 1898. Pp. 319.

This volume is published under the auspices of the Allgemeiner Verein für Deutsche Litteratur. The title is misleading, as one would imagine that Dr. Dove travelled from the Cape to the Nile on land. As a matter of fact, he went from the Cape overland to the east coast and then by steamer to Suez. There is nothing very new in the volume, but it is a pleasant collection of letters which will probably be read with interest by those to whom they were written. The author's remarks on the British troops are far from correct. Although he appears to like their uniform, he objects to their athletic sports, and seems to think that a paid army has no love for the Fatherland, and rather ignominiously dies for money in the trenches. He remarks that he has seen some highly educated English officers, men with whom he liked to converse, but they were everything else except officers, that is to say, in the only right sense, the military sense (p. 44-45). The illustrations are very good.

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Die Republik San Marino. Eine Studie. Von CARL AMICO. Augsburg: A. Himmer, 1899. Pp. 159.

"With no other protection but its smallness, its poverty and its solitude, amidst lofty and almost impassable hills, San Marino, the smallest town in Europe, has through all the storms of the times, maintained its independence from the fourth century till now." Its population is about 9500, mostly peasant proprietors, for its traders are few. The whole population is Roman Catholic. Its chief productions are coarse silk, gut-strings, soap, and perfumes. Although occupying a lonely and lofty cradle among the Apennines, San Marino is well governed, and the present pamphlet gives a complete review of its history and institutions.

Missionary Travels and Researches in South Africa. By DAVID LIVINGSTONE, M.D. With Notes by FREDERICK STANLEY ARNOT. London: John Murray, 1899. Pp. xiv + 447. *Price* 5*s.*

The present edition of Dr. Livingstone's first journey in Africa is in a handy form, and neatly got up. Most of the original illustrations are contained in it, and fresh ones have been added, but there is no portrait. Mr. Stanley Arnot contributes some instructive notes.

Cities and Sights of Spain. A Handbook for Tourists. By E. MAIN. London: George Bell and Sons, 1899. Pp. 214.

One of the best-known guidebooks to Spain anticipates that the tourist in Spain will, like Don Quixote, travel on horseback. The author of the present little handbook remembers that we live in a railway age, and except where driving is necessary to see sights, takes us by railway round Spain, and points out what is best worth seeing in that marvellously interesting country. In the course of a circular tour of fifty-four days, it is shown that all the most notable places in Spain can be pleasantly visited, and the author, with practical common sense, apportions to each day exactly what can and ought to be seen. The book is amply and prettily illustrated from photographs by the author, and should be welcomed as a handbook which does not make the tourist attempt too much, and which is easily carried. As the study of architecture is one of the charms of Spanish travel, two pages are given of "Illustrations of Architectural Terms," both as regards the internal and external features of buildings.

Hazell's Annual for 1900: a Cyclopædic Record of Men and Topics of the Day. Edited by W. PALMER, B.A. (Lond.). London: Hazell, Watson, and Viney, 1900. Pp. 702.

The editor of this useful annual has, at any rate so far as geographical affairs are concerned, "followed diligently the flight of events." The Anglo-French convention respecting the Bahr-el-Ghazal, the Anglo-German relating to Samoa, the neutral territory in West Africa, and Zanzibar, and the present state of the Alaskan boundary question, are all duly recorded. Exploration has chiefly taken place in the Polar regions, and the achievements of the various expeditions are reported. Here, however, there are a few slips; Peary, and not Sverdrup, has explored Ellesmere Land, or rather part of it; the Danish explorer's name is Amdrup, not Andrup; and the name of the islands near which the *Southern Cross* was caught in the pack is Balleny not Bellamy. We hope that in future the spellings of the Canadian Geographic Board will be adhered to for places within the Dominion.

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Statistical Year-Book of Canada for 1898. Issued by the Department of Agriculture. Ottawa: Government Printing Bureau, 1899. Pp. 606.

The new *Year-Book* is arranged under precisely the same headings as previous issues, but several chapters are extended. Agricultural statistics and mining, in particular, demand more space. This publication has been noticed so often in these pages that it is only necessary to remark that Mr. Johnson, the statistician, keeps the work up to a high standard of completeness and accuracy.

Aarbog for Dansk Kulturhistorie. Udgiven af POUL BJERGE. Kjøbenhavn: Lehmann og Stage, 1899. Pp. 192. *Price* 2 *Kr.*

The editor has again given us an interesting collection of essays. Perhaps the best is "Den Gamle Danske Landsby," by P. Lauridsen. The author treats fully of the names of villages and their origin, their plan, the partition of the land for farming purposes, etc. Most of these old customs prevailed in our country, and the article will be interesting to students of land tenure in the earlier periods of our history. H. F. Feilberg, a constant contributor, has collected legends and anecdotes relating to fire and the hearth and customs connected with them.

Illustrated Guide for Tourists to the Darjeeling Himalayan Railway and Darjeeling. 1896. Pp. 46.

This little book, which is profusely illustrated with photographic views and plans, has been issued by the Railway Company. It gives an interesting account of the old route from the plains to Darjeeling, and traces the history of the mountain railway, describing the country through which it passes. It would certainly be found a useful companion to any traveller making the journey from Calcutta to the summer quarters of the Bengal Government. The railway was destroyed in many places by the late earthquake, but it will of course be rapidly restored.

Nedbøriagttagelser i Norge. Udgivet af det Norske Meteorologiske Institut. Aargang 1, ii. og iii., 1895 Juli, 1897 December. Kristiania: W. C. Fabricius og Sønner, 1899.

Regular rainfall measurements have been made at the astronomical observatory at Christiania since 1839, and after the establishment of the Meteorologiske Institut the number of stations increased year by year, and were properly controlled by the Institut. The results were published by the Institut and by Professor Mohn in scientific periodicals. But a great advance was made in 1895, when 263 new stations for rainfall measurement were established at the expense of the Government, to which more were added in 1896 and 1897.

The present work contains tables of observations taken at all the stations during the whole or part of the period of two years and a half. The total number of stations is 425, but the daily observations of only 200 stations are published, those being chosen where the observations were most carefully made, the distribution of stations equally over the country being also kept in view. In the second volume the monthly and annual means are given, greatest fall in one day, number of rainy days, depth of snow, etc., at each station. The positions of the stations and their heights above sea-level are contained in a table at the commencement. The work has in every respect been compiled with care and thoroughness.

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NEW MAPS.

EUROPE.

ITALIE SEPTENTRIONALE. Atlas Universel de Géographie, ouvrage commencé par M. Vivien de Saint Martin et continué par Fr. Schrader. No. 22. Echelle de 1 : 1,500,000. *Hachette and Co., London.*

The map of North Italy, southwards to Gaeta, is very neatly and clearly drawn, and the mountains are not, as is often the case, printed so dark that it is difficult to read the names among them. The railways are also sufficiently distinct. Corsica also finds a place in this map. The latest Italian surveys have been utilised.

AFRICA.

BAS-CONGO, Carte du ——, à l'échelle du 500,000e. Dressé par H. Droogmans, Secrétaire Général du Department des Finances de l'État Indépendant du Congo. *Presented by the Compiler.*

Much useful information is embodied in this map, such as telegraph lines, points astronomically fixed, forests, and other surface features. Its chief importance, however, is as an index-map to the larger map of the Lower Congo on the scale of 1 : 100,000.

ATLAS.

SCHWEIZ, Topographischer Atlas der ——, im Massstab der Original-Aufnahmen, nach dem Bundesgesetze von 18 Dezember 1868 durch das eidg. topogr. Büreau gemäss den Direktionen von Oberst Siegfried veröffentlicht. *Presented by Professor Paul Chaix.*

Lieferung XLVIII.:—

No. 275 Alpbella.	No. 421 *bis* Reschenscheideck.	No. 452 Jussy.
„ 302 Montricher.	„ 431 *bis* La Cure.	„ 453 Carouge.
„ 416 *bis* Gross Litzner.	„ 432 Arzier.	„ 478 Pillon.
„ 417 *bis* Martinsbruck.	„ 451 Genève.	„ 501 *bis* Crodo.

PHOTOGRAPHS.

During the past session the following photographs have been added to the Society's collection :—

AFRICA. South end of Lake Tanganik *Presented by Mr. E. K. Carmichael.*

Five views of Graaf Reinet and neighbourhood. *Presented by Mr. George Rattray.*

AMERICA. Forty-seven views in the West Indies. *Presented by Mr. A. G. Nash.*

Ten views in the Barren Lands of Canada. *Presented by Mr. J. B. Tyrrell.*

AUSTRALASIA. Eighty-two views in New Guinea, New Britain, the Solomon Islands, and the Santa Cruz group. *Presented by Mr. Chas. M. Woodford.*

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE LATE MARQUESS OF LOTHIAN, P.C., K.T., LL.D.,

Late President of the Society.

By the death on 17th January of the Marquess of Lothian Scotland lost one of the most popular noblemen she ever possessed. His was not a popularity acquired by political ascendency, for Lord Lothian was never much of a partisan; nor was it the result of eloquence, for he was no orator; nor was it because of his intellectual power, for he was not given to controversy. It was his personal charm, his faultless manners, his genial conversation; it was the conviction which every one had in his presence that he was a thorough gentleman, a man of perfect truth and absolute honour—it was this that gave him a position in the hearts of his countrymen, which neither rank nor power nor intellect could ever have secured.

Schomberg Henry Kerr, ninth Marquess of Lothian, was born in 1833, and was educated at Glenalmond College, at Eton, and at New College, Oxford. At the age of twenty-four he began his long and distinguished career by being attached to the staff of Sir James Outram during the latter's successful Persian campaign.

Members of our Society will remember Lord Lothian's relating at one of the Society's meetings how, when in Persia, he had climbed a lofty mountain, which had never been ascended by a European. He said he climbed it simply for amusement, but added that that mountain gave him his introduction to Geography, for, on relating his adventure to a Russian diplomatist at Teheran, the latter at once asked the height of the mountain. Lord Lothian felt annoyed at not being able to answer this question; but, with characteristic energy, he obtained the necessary instruments, ascended the mountain again, ascertained its altitude, and presented his Russian friend with the result of his observations.

Entering the Diplomatic Service, Lord Lothian was in 1862 appointed Second Secretary to H.M. Legation at Frankfort-on-Maine, and in 1865 to the same position in Madrid, and afterwards in Vienna. Owing to the death of his brother in 1870, Lord Lothian's diplomatic career was brought to a close. He succeeded to the Marquessate, and he now devoted himself to the multifarious duties of a great landowner in

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Roxburghshire and Midlothian. Needless to say that his tenantry and the people in the vicinity of his seats, Monteviot near Jedburgh, and Newbattle Abbey near Dalkeith, held him in the highest esteem, and no Kerr of Ferniehirst (of which ancient family he was the head) ever received from Borderers greater respect than Schomberg Henry Kerr.

If Lord Lothian learned Geography in Persia, he found abundant opportunities for studying Architecture and Archæology on succeeding to his brother. That enlightened nobleman had long cherished the hope of rescuing the magnificent Abbey of Jedburgh from the architectural degradation to which it had been subjected by a sordid age. With this view he, at great expense, had acquired possession of the Abbey, and had built elsewhere a church for its congregation, but he died ere the Abbey was cleared of modern encumbrances. It was to the late Lord Lothian that this duty fell, and he most piously executed it, evincing a knowledge and zeal which were recognised in 1876 by his election as President of the Society of Antiquaries of Scotland.

In 1882 Lord Lothian received from the University of Edinburgh the degree of Doctor of Laws, and in 1887 he was elected Lord Rector of the University. His antiquarian tastes led to his appointment in 1883, and again in 1886, as a Member of the Royal Commission on Historical Manuscripts.

Next year he was appointed Secretary for Scotland, an office which he held till 1892, giving satisfaction to all with whom he had official dealings, and receiving the Freedom of the City of Edinburgh, over whose Forestry Exhibition in 1884 and International Exhibition in 1886 he had presided with much success.

It was in June 1887, whilst Lord Lothian was Secretary for Scotland, that our Society, during Her Majesty's Jubilee year, received from the Queen the title of the "Royal" Scottish Geographical Society, he having brought the matter before Her Majesty, at the request of the Society's President, the Earl of Rosebery.

In 1894 Lord Lothian was elected President of our Society, and devoted himself to its interests and to those of Geographical Science generally with considerable energy. He strongly advocated that, for the credit of Britain, as well as for scientific reasons, a grant should be made by Government in aid of Antarctic exploration. He frequently, although unavailingly, applied to H.M. Treasury to remit the rent which is exacted from our Society for its Rooms in Edinburgh, although they are always open to the public desirous to consult Maps, etc. He made every effort, officially and unofficially, to obtain Admiralty charts for our Society's Rooms in Glasgow; and on intimating, at the Society's Annual Meeting on 17th November 1898, his want of success, he remarked: "Other Governments provide charts for consultation free of charge, and I regret that the British Government has absolutely declined to furnish these charts to our Society."

Lord Lothian entered no walk of life which he did not adorn, he occupied no office the duties of which he did not faithfully discharge, and when he died Scotland mourned not merely a nobleman of urbanity and distinction, but a Scotsman who, in his day, had done his best to advance the higher interests of his country.—R. R.

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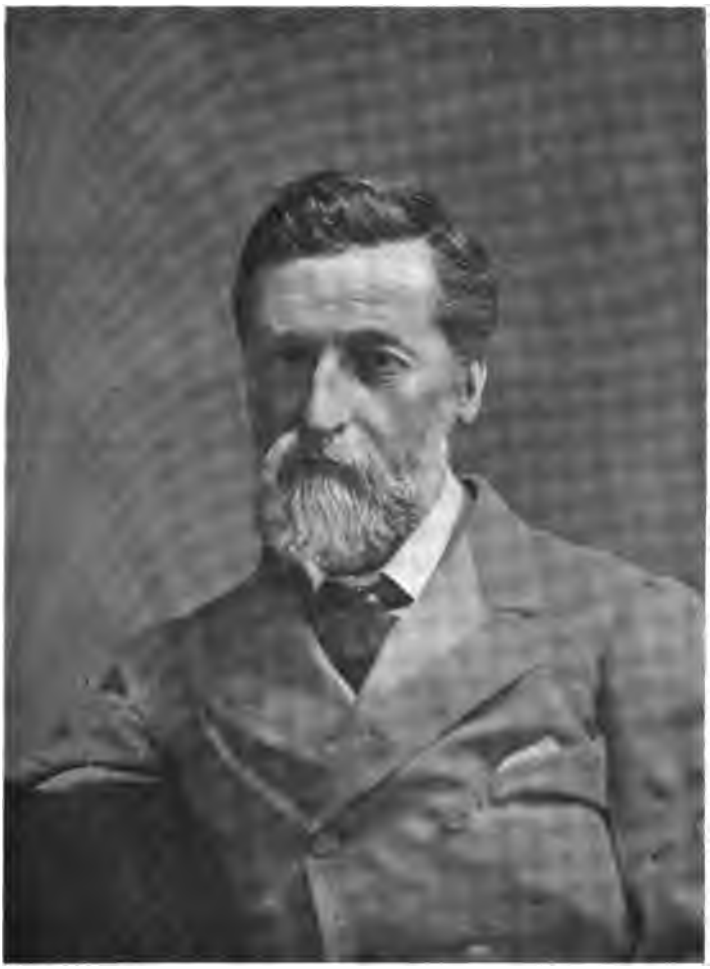

THE LATE MARQUESS OF LOTHIAN, P.C., K.T., LL.D.

From a Photograph by Horsburgh, 4 West Maitland Street, Edinburgh. *Copyright.*

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A WHITE-HOT LIQUID EARTH AND GEOLOGICAL TIME.

By Professor JAMES GEIKIE, D.C.L., LL.D., F.R.S.

IT is sometimes brought as a reproach against geology that we cannot obtain from it any definite statement as to the time which has elapsed since the oldest sedimentary strata began to be deposited. Unfortunately the evidence that appeals most strongly to a student of the stony science is not often of a kind which others can readily appreciate. He may occasionally attempt a rough computation of the time required to form a given thickness of strata, but the conditions that determine the rate of erosion and deposition are so varied that he has but little faith himself in the exactness of the results obtained. Were twenty geologists invited to make just so many independent estimates of the duration of the Carboniferous period, possibly no two of those estimates would agree even approximately. But each geologist would doubtless subscribe readily to the statement that the period in question probably extended over several million years. It is needless to tell a knight of the hammer that estimates so vague as this must be quite unreliable and unworthy of credence. A traveller who has painfully made his way across some trackless continental area, without maps or any means of measuring exactly the distance traversed, if he cannot tell us precisely how many miles he has walked, will nevertheless feel assured in his own mind that the journey has been a very long one. The reality of a great distance covered is just as patent to him as if his route had been carefully mapped and accurately measured. Just so is it with the geologist. Judging from what is known of the operations of nature in our own day—reasoning, in short, from the present to the past—he is convinced that the history of our earth from the introduction of life cannot be comprised within a few million years. Deeply impressed by the prolonged succession of geological events—the multitudinous changes of land and sea—the protracted process of earth-sculpture—the great oscillations of climate—the gradual coming in and dying out of whole faunas and floras—it is not strange that he should sometimes speak of the time during which life has existed on the earth as "incomprehensibly vast." It is not at all likely, indeed, that geology will ever be able to tell us how many years have passed away since life first appeared upon our planet. Her answer to all inquiries of this kind will doubtless continue to be that of the old man in the ballad :—

> "I cannot tell, I do not know,
> But 'twas a long, long time ago."

But if the geologist has no unqualified faith in estimates of past time even when these are based upon the average rate at which natural operations proceed at present, he nevertheless recognises that calculations of this kind lend a certain precision to his appreciation of the work done in the past. They can never be more than approximations to the truth, but even so they have convinced him that the geological past is not "practically infinite," as was at one time supposed; he knows now that

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the great demands formerly made by his science upon the bank of time are not justified by our knowledge of the present. But while such computations as he is able to make have set bounds to his horizon, they have at the same time assured him that geological time cannot be comprised within the narrow limits recently prescribed by Lord Kelvin.

When the attention of physicists was first turned to the question of geological time great things were hoped for. Assuming the nebular hypothesis to be true, and supposing, therefore, that the earth had cooled down from a red-hot liquid condition, it was conceivable that physical research should be able to give us an approximate date for the beginning of geological time—for the period when encrustation was completed and the earth became fitted to be the abode of life. Some five-and-thirty years ago, therefore, geologists were interested to learn from Sir William Thomson (now Lord Kelvin) that the time which has elapsed since the surface of the earth was everywhere red hot could not be less than 20 millions nor more than 400 millions of years. By and by, however, this generous range of time was reduced, and geologists then heard that all their wonderful earth-history must be comprised within 100 million years or less. Even this moderate allowance is now cut down, and Lord Kelvin tells them he has good reason for judging that the time which has passed since the consolidation of the earth was between 20 and 40 millions of years, and probably much nearer 20 than 40.

There must be few, if any, geologists willing to admit that "20 or 25 million years" is a reasonable estimate of the time which has elapsed since the period of encrustation. We have, indeed, reliable grounds for doubting whether even the former estimate of 100 million years can span the whole course of geological history. Many, therefore, have come to view the physical conception of the evolution of the globe with considerable doubt, and to believe that physicists have overstated their case. One cannot fail to see that, after all, the physical theory is not founded upon facts, but assumptions. It is based upon the hypothesis that the whole surface of the earth was at one time enveloped in an ocean of red-hot or white-hot liquid lava. If we accept this assumption then we must apparently also accept Lord Kelvin's conclusions. But those conclusions do not harmonise with the geological evidence, and one is forced, therefore, to suspect either that the assumption on which the whole physical theory rests is not true, or that there is some unsuspected error in the elaborate computations based upon it.

If the physical theory be well founded, it ought surely to throw some light on the origin of our great mountain ranges. These are long wrinkles formed, as geologists believe, by the contraction or shrivelling of the earth's crust. Let us see, then, how the physical theory works out in the case of such mountains.

If the earth be a cooling body which has solidified from a liquid condition, it is obvious that there must be a passage downwards from the cooled crust into the still uncooled nucleus. At some depth from the surface, therefore, a level will be reached at which the interior has not yet begun to cool and contract. All the matter above that level constitutes the crust, which we may for the moment think of as consisting of

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two concentric shells. The inner one, resting immediately upon the uncooled nucleus, is cooling and therefore contracting, and consequently must be in a state of tension. But owing to the enormous pressure of the overlying crustal shell, it cannot yield to tension by actually rupturing. It is simply stretched, and the stretching must diminish upwards until a level is attained where it will cease altogether. That level we may consider the boundary of the two crustal shells. Above this boundary the crust is not subject to lateral tension, but to lateral compression; the external crustal shell is not stretching but shrivelling, and that process increases upwards so as to reach its maximum at the surface. There are thus two kinds of contraction to which the earth's crust is subjected, namely, *circumferential* below, and *radial* above. Where the former is in excess stretching is most marked, where the latter prevails lateral compression is dominant—where the one equals the other there is no strain. It is, therefore, only in the outer crustal shell above this neutral zone or level-of-no-strain, that folding of the crust can take place.

On the assumption that the earth has solidified from a white-hot liquid condition, it follows that the thickness of the upper crustal shell must be proportional to the time which has elapsed since encrustation was completed. To put it in another way, the neutral zone or level-of-no-strain must formerly have been much nearer the surface than now, and must continue to descend with the gradual cooling of the globe. On the supposition that encrustation took place 100 million years ago, some physicists have estimated the depth of the neutral zone to be two miles or so, while others put it at seven or eight miles. But if only 25 million years have passed since the earth at the surface was a white-hot liquid, it is obvious that the neutral zone cannot be nearly seven miles from the surface, for "the depth is proportional to the time since consolidation." How far, then, does this conclusion harmonise with the results of geological investigation?

All the larger mountain chains of our globe belong to the class of Folded Mountains, and owe their origin to deformation of the crust. So far as known, mountains of this class are composed of a very great thickness of strata, exceeding in some cases 50,000 feet. Originally arranged in approximately horizontal positions, the beds have subsequently been subjected to intense lateral compression, whereby they have been flexed, folded, convoluted, contorted, and dislocated in a most extraordinary manner. So severe, indeed, has been the compression that in some cases the strata have lost a fourth and sometimes even a half of their former extension. In the Jura Mountains between the Lake of Geneva and St. Claude, for example, the contraction by folding is equal to three miles, or one-fourth, while in the Eastern Jura it is greater. But not only are the strata closely folded and convoluted, they frequently show approximately horizontal lines or planes of displacement along which masses of rock, measuring many hundred feet in thickness, have been pushed forward for distances of ten miles and more. In a word, all the phenomena characteristic of mountain-structure demonstrate that this is the result of intense lateral compression.

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Many have been the views held as to the origin of folded mountains; it is now generally believed, however, that they are due to crustal wrinkling, consequent on the secular cooling of the globe. Other possible sources of lateral compression have been suggested, but each of these has proved entirely insufficient. The contraction-theory alone seems to give a satisfactory explanation of mountain structure and its concomitants; failing it, indeed, the origin of folded mountains becomes inexplicable. Assuming, then, that rock-folding on the large scale is the result of shrinkage and consequent wrinkling, let us take a few well-known geological facts into consideration. The Appalachian Chain came into existence towards the close of the Palæozoic era. Now the strata entering into the formation of these mountains attain a thickness of 40,000 feet. The width of the strata before lateral compression affected them was over 300 miles, but is now less than 250 miles. In other words, the strata, by folding and lateral displacement, have lost probably more than 50 miles of their original width. If we accept the physical conception of crustal evolution, we must therefore believe that the external crustal shell attained a thickness of more than seven miles before the close of Palæozoic times. But according to the physicists it would take 100 million years of cooling to cause the level-of-no-strain to descend to a depth of seven miles from the surface. Take another case: in the European Alps—an uplift of relatively recent age—we find a thickness of over 50,000 feet of strata. On the same principle, therefore, we must infer that the neutral zone had descended ten miles before the close of Tertiary times; and this would imply very considerably more than 100 million years of cooling. Now, if physicists have not erred in their methods of estimating the depth of the level-of-no-strain, it would seem evident that encrustation must have taken place more than 100 million years ago, and assuredly very much more than 25 million years ago.

There are certain other considerations which increase one's doubts as to the adequacy of Lord Kelvin's theory of crustal development. Even if we admit the possibility that within 25 million years from the period of encrustation the level-of-no-strain had descended so far as to allow of the folding and plication of an external crustal shell ten miles in thickness, it seems more than doubtful whether the radial contraction of the globe would suffice to produce the phenomena of mountain-structure. The Rev. O. Fisher has made several interesting calculations to show that folded mountains cannot owe their origin to contraction of the earth's crust—that is to say, a crust which has solidified from a molten mass. Assuming the temperature to be 7000° F. at the time of solidification, and that 98 millions of years have elapsed since the period of encrustation, Mr. Fisher estimates the total radial contraction of the globe at six miles. With a lower initial temperature and a shorter period of cooling the contraction would necessarily be less. Thus, taking 4000° F. as the temperature of consolidation, and 33 million years as the time that has elapsed since encrustation, the total radial contraction, according to the same physicist, would be only two miles. But if, with Lord Kelvin, we assume the temperature to have

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been about 1420° C. (2588° F.) and the time of cooling 20 to 25 million years, the radial contraction would not be even so much as two miles. Now a radial contraction of two miles would give a circumferential or lateral contraction of fourteen miles or thereabout. It is obvious that so limited an amount of contraction is entirely inadequate to explain the phenomena of mountain-structure. The strata buckled up in individual mountain-ranges have, in a word, experienced a greater amount of contraction than the physical theory of crustal evolution would allow for the whole globe. Mr. Fisher and other physicists have, therefore, maintained that folded mountains cannot owe their origin to wrinkling of the crust consequent on the secular shrinkage of the globe. But their estimates and conclusions only tend to show that the theory of crustal evolution at present in vogue is probably not well-founded. Here, then, we come to an *impasse*—geologists are convinced that the convolutions, great horizontal displacements, and other phenomena of our folded mountains can only be the result of contraction, while physicists present them with a theory which cannot be harmonised with that conclusion.

The larger inequalities of the earth's surface—the continental plateaus and oceanic basins—are not more readily accounted for by the physical theory. On the supposition that a white-hot lava ocean formerly enveloped the globe, it seems reasonable to infer that cooling would take place equally everywhere, and that encrustation, therefore, would result in the production of an approximately uniform surface. The radial contraction of a globe so encrusted could not possibly give rise to the larger surface-features just referred to. Lord Kelvin admits that "if the shoaling of the lava-ocean up to the surface had taken place everywhere at the same time, the whole surface of the consistent solid would be the dead level of the liquid lava all round, just before its depth became zero. On this supposition," he continues, "there seems no possibility that our present-day continents could have risen to their present heights, and that the surface of the solid in its other parts could have sunk down to their present ocean depths, during the twenty or twenty-five million years which may have passed since the *consistentior status* (*i.e.* the state of complete solidification) began, or during any time however long." He would therefore account for the continents and oceanic basins by supposing that these inequalities of surface "are due to heterogeneousness in different parts of the liquid which constituted the earth before its solidification." It is very hard, however, to understand how such a lava-ocean should have varied so much in its chemical composition. Presumably its component materials must have been as well-mixed as are those of igneous rocks in the original molten magma from which they solidify. Lord Kelvin himself in picturing the conditions that took place during the shoaling of his hypothetical lava-ocean, describes how the loss of heat from the white-hot surface would produce very rapid cooling of the liquid within a few centimetres of the surface, and in consequence great downward rushes of this cooled liquid, and upwards of hot liquid, spreading out horizontally in all directions, when it reached the surface. If such were the conditions, surely the

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white-hot liquid must have been tolerably well stirred, and it is difficult to conceive how its chemical composition should have varied to such an extent as to give rise on cooling and solidification to well-defined continental plateaus and oceanic depressions. If, following Professor Chamberlin, we "conceive the hypothetical lava-ocean to have been one great *solution*, stirred by convectional and other currents, and depositing crystals as supersaturation arose from change of temperature or from change in the solution itself, there seems not much more reason to suppose that its deposits would have been localised persistently on the sites of the present continents than to suppose that the present enveloping solution—the ocean—if duly concentrated, would localise in a similar way the crystals which it would throw down."

We come, then, to the general conclusion that if a white-hot lava ocean enveloped the globe 20 or 25 million years ago our folded mountains cannot owe their origin to the wrinkling and shrivelling of the crust, nor can the larger inequalities of the earth's surface be due to movements either of elevation or of depression. But the evidence of compression —of crustal squeezing, thrusting, and lateral and vertical displacement— is so conspicuous and so incapable of being misread that geologists are not likely to give up their contraction theory. They will insist that physicists who speculate on the subject of crustal evolution must first take into consideration the actual facts of crustal deformation and the genesis of rocks. No theory, however brilliant and plausible, can meet with acceptance if it be inconsistent with the well-ascertained results of geological and petrological observation.

In a very interesting essay recently published in *Science* (June and July 1899), Professor Chamberlin has examined Lord Kelvin's theory in some detail. He points out that this theory is confessedly based upon a hypothesis. To use Lord Kelvin's own words, it is "founded on the very sure assumption that the material of our present solid earth all round its surface was at one time a white-hot liquid." The certitude of this assumption is challenged by Professor Chamberlin, who remarks, by way of preface to his criticism, "that the postulate of a white-hot liquid earth does not rest on any *conclusive* geological evidence, however generally it may be entertained as a probable hypothesis." It is, in point of fact, chiefly a deduction from the high internal temperature of the earth, and from the nebular hypothesis. But, as Professor Chamberlin says, "it remains to be shown that the high internal temperature may not also be the sequence of an earth which grew up by meteoric accretion with sufficient slowness to remain essentially solid at all stages"—the highly-heated state of the interior necessarily resulting from the self-compression of the mass during its accretion.

We may believe with Lord Kelvin that the earth was almost certainly built up of meteorites falling together, but are not necessarily compelled to infer that the result of their impact would be a gaseous or even a white-hot liquid condition. Everything would depend on the rate at which the bodies clashed together. If they fell in simultaneously at a sufficiently high velocity, no doubt an intensely hot condition would follow—either liquid or gaseous. But if they fell sporadically, at as

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great intervals as they do to-day, a low surface-temperature would be the result. If, on the other hand, the ingathering took place at some intermediate rate, an intermediate thermal state would follow. Professor Chamberlin therefore concludes that "before a white-hot condition can be regarded as a safe assumption, it must be shown that the meteoroids would necessarily fall together at a highly rapid rate, otherwise the heat of individual impacts would be lost concurrently, as is now the case, and would not lead to general high temperature." Probably the meteorites constituted a swarm or belt revolving round the sun in the path now followed by the earth, and resembled in their distribution those shoals of minute bodies which form the rings of Saturn. So long as these minute bodies are under the tidal influence of that planet they cannot clash together to form an independent satellite, but we do not know how they would behave were they to be removed so far from Saturn as to be beyond the sphere of specially intense tidal strain. Escaped from the tidal influence which had kept them apart, would they at once clash together? Professor Chamberlin thinks that it is difficult to demonstrate "even the method by which the meteorites would aggregate, much less the rate, or even to demonstrate that, apart from extraneous causes, they would fall together at all. Is not the presumption in such a case," he continues, "favourable to a slow rather than to a rapid aggregation?" The probable behaviour of a swarm of meteorites revolving round the sun in the orbit of the earth is in truth a very hard problem to solve. For, as Mr. Chamberlin remarks, it "involves the balance between gravitative forces, revolutionary forces, and tidal forces, and the gravitative forces are not simply those between the meteorites mutually, but those between the meteorites, and the central solar body, and the exterior planetary bodies." "Is it certain," he asks, "that these forces would be so related to each other as to produce a swift ingathering of the whole swarm or belt, or, on the other hand, an ingathering prolonged through a considerable period? If the latter be the case (and, in the absence of demonstration, is it unreasonable to think it quite as probable as the opposite), are there any imperative grounds for assuming that a liquid state of the earth would result?"

After indicating that, so far as regards the amount of sensible heat at the beginning of the habitable stage of the earth's history, there is no great difference between Lord Kelvin's hypothesis and his own, Mr. Chamberlin remarks that in a meteor-built earth, solid from the beginning, much less heat would be lost by convection than in the case of a liquid earth. But the two hypothetical earths would differ most notably in regard to the proportion of potential energy convertible into heat which remained within the earth when full grown. In a white-hot liquid earth the material would be readily arranged according to its specific gravity, so that its potential energy, or energy of position, would be practically exhausted. But this would not be the case in a solid earth built up by the accretion of meteorites. In such a case there could be no free readjustment of material, so that heavier and lighter stuff would be confusedly commingled throughout the whole body of the earth, "except only so far as the partial liquefaction, and the very slow, plastic,

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viscous, and diffusive rearrangement of the material permitted an incipient adjustment to gravitative demands." Readjustment would thus proceed very slowly, potential energy becoming gradually converted into heat as local liquefaction and internal movements permitted the sinking of the heavier and the rise of the lighter material—a process which is presumably still in progress. This descent of the metallic and other heavy materials towards the centre, and reciprocal ascent of lighter materials from the central region towards the surface, is supposed to have its superficial manifestation in volcanic action. So that "besides developing heat in proportion to the work done, it incidentally brings the hotter material of the interior toward the surface, and thus increases the sub-superficial temperature." It is a kind of slow convection, not radically different from that which is supposed to have taken place in the hypothetical liquid earth. In the case of the latter, however, the heat was brought to the surface and dissipated before the earth could have been habitable, while in the case of an earth solid from the beginning the process would be delayed, and the heat become available even while the surface was fitted to be the abode of life.

In a liquid earth the conditions would necessarily favour a ready adjustment of materials, such chemical and mineral combinations taking place as best accorded with the internal pressures. But in a heterogeneous solid earth all combinations of the kind would be restrained and delayed, and could take place only slowly during the gradual readjustment of the internal material. Thus throughout the ages a process of rearrangement and recrystallisation would be carried on under high pressure, and the density of the interior would increase, while heat would, at the same time, be set free. Increasing density "would furthermore permit the shrinkage of the whole mass and the consequent intensification of its self-gravitation, and this would in turn result in further development of heat."

Such is a brief outline of some of the leading features of Professor Chamberlin's alternative hypothesis of a meteor-built earth, solid from the first. Whether it will stand the test of radical criticism remains to be seen. But it certainly satisfies geological requirements, which are not met by Lord Kelvin's hypothesis. In particular, as Professor Chamberlin points out, the loss of heat from the earth, as computed by physicists, and the shrinkage resulting therefrom, are quite incompetent to produce the observed inequalities. The phenomena of our folded mountains, as we have seen, imply a degree of deformation which the liquid-earth hypothesis forbids. We must agree with Professor Chamberlin, therefore, that the formation of folded mountains, and the still larger inequalities of the earth's surface, demand a more deep-seated agency than that which is supplied by superficial loss of heat; and we are at one with him in thinking "that an earth of heterogeneous constitution, progressively reorganising itself, would give larger possibilities of internal shrinkage, and that the shrinkage must be deep-seated as well as superficial."

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THE LAND OF PARROTS.

By Captain PASFIELD OLIVER.

PART II.

AN EARLY FRENCH VOYAGE TO MADAGASCAR EXAMINED.

MR. ROBERT E. GRAVES, the Keeper of Printed Books in the Library of the British Museum, informs me that there is in their collection a copy of Paulmier's *Mémoires*. This may, possibly, be the identical book which was in Falconet's library at Lyons, to which M. de Brosses alludes.[1] Unfortunately it is without the mappemonde of A. De Fer. The title-page has been photographed by Mr. Dosseter, and is herewith reproduced.

It may be convenient now to mention some of the principal maps in which the fabulous Southern continent has been shown as existing in comparatively low latitudes, under various names. M. d'Avezac, the well-known author, who has made this subject his own, claims for his countrymen—as will subsequently be seen—the credit of having first discovered the southern portions of the American continent: and it is to the vague tradition of Gonneville's expedition that he ascribes the tracing by geographers in the sixteenth and seventeenth centuries of the vast Austral continent surrounding the Antarctic Pole and extending its coasts to the straits of Magellan, where it appears under the name of *Terra del fuego*, or Lower Brazil, elsewhere, towards South Africa, as the *Promontorium Terræ Australis*, and further east towards the Indian Archipelago as *Terra de Vista*, *Terra Vitæ*, or *Terra descubierta*.[1] M. d'Avezac enumerates the following maps, after the globe constructed by Jean Schœner[2] in 1520, of which the western hemisphere has been republished, at Nuremberg, by Dr. Ghillany in 1842 and 1853. On this is seen marked *Brasilia inferior*, extending beyond latitude 40° S., all the positions of this coast being monstrously pushed towards the south. On the same globe is also marked between the 10th and 20th parallel, *America vel Brasilia sive Papagalli Terra*.

On the great chart of Mercator, of 1569, is to be found the following legend:—"*Hic in latitudine* 42 *gr.: distancia* 450 *leucarum a capite Bonæ Spei, et* 600 *a promontorio S. Augustini inventum est promontorium Terræ Australis, ut annotavit Martinus Fernandus Denciso sua Summa Geographiæ.*" Mercator also shows on his large mappemonde the following:—"*Psittacorum regio sic a Lusitanis huc libegio vento appulsis cum*

[1] In the *Suma de Geographia* of Enciso, the *Terra de Vista* is ascribed to the Portuguese discoverers, followed by the Spanish and Italians, as having viewed but not landed this shore. Again, this is shown in the *Universale descrittione di tutta la Terra conosciuta fin qui* of Paul Forlani, published at Venice in 1563. Enciso also gives the *Promontorium Terræ Australis* in his description of the Cape of Good Hope, which is quoted on the chart of Mercator.

[2] Johann Schoner, of Carlstadt, constructed his globe at Bamberg in 1520, and it is now in the town library of Nuremburg. A line on it shows the track of Magellan's ships. See Introduction to Hues' *Treatise*, by Sir Clements Markham, Hakluyt Society's Edition, 1889, p. xviii.

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42.e

MEMOIRES

TOVCHANT

L'ETABLISSEMENT

D'VNE

MISSION CHRESTIENNE

DANS

LE TROISIEME MONDE,

Autrement appellé

La Terre Australe, Meridionale, Antarctique, & Inconnuë.

Dediez à Nostre S. Pere le Pape

ALEXANDRE VII.

Par vn Ecclesiastique Originaire de cette mesme Terre.

A PARIS,

Chez CLAVDE CRAMOISY, ruë Saint Victor, proche la place-Maubert, au Sacrifice d'Abel.

M. DC. LXIII.

AVEC PRIVILEGE DV ROY.

10

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Callicutum peterent appellata propter earum avium ibidem multitudinem. Porro cum hujus terræ littus ad 2000 *miliarum prosequuti essent, necdum tamen finem invenerunt, inde Australem continentem attigisse indubitatum est.*"

On the well-known globe of Emery Molyneux, the Lambeth mathematician, now preserved in the Middle Temple Library, and constructed for Mr. William Sanderson in 1592, is shown "the great Southern continent, which is made to include Tierra del Fuego and the south coast of Magellan's Strait, and extends over the greater part of the south frigid zone."[1] "The achievement of Mr. William Sanderson is painted on the imaginary southern continent to the south of Africa."[1]

In Robert Hues' treatise descriptive of the Molyneux globes, *Tractatus de Globis et eorum usu*, 1592, that author, writing of the *Terra incognita*, states:—"There are also many other parts of the world not yet thoroughly known or discovered, as, namely, those Southerne coasts wherein stands Nova Guinea, lying beyond the Indian Sea, which, whether it be an Island or part of the Maine Continent, is not yet discovered; and likewise that other tract of the Southerne unknowne Continent which is called Magellanica. . . . ."

I have not been able to obtain a copy of the *terra incognita* marked on the Molyneux globe, but as Mr. Robert Hues praises the "Geographicall" Tables of Abrahamus Ortellius, "whose diligence and industry in this regard seems to exceed all other before him," it may easily be supposed that Molyneux followed this geographer in tracing his southerne coasts up to Nova Guinea lying beyond the Indian Sea, as well as that author's Magellanica.

We are able to give a reproduction of a small inset mappemonde by Ortellius, entitled *Typus orbis ad investigandum Ophir*, in which it may be observed that the locale of Ophir is unhesitatingly attributed to Menuthias, *i.e.* Madagascar. It is taken from *Abrahami Ortellii Theatri Orbis Terrarum Parergon, sive Veteris Geographiæ Tabulæ commentariis Geographicis et Historicis illustratæ. Tabulis aliquot aucta et varie emendata atq. innovata cura et studio Balthasaris Moreti. Antverpiæ ex officina Plantiniana*, 1595. The same antarctic lands had appeared in the first edition of the great *Theatrum Orbis Terrarum*, published by Ortellius in 1570.

The mappemonde engraved by De Fer, to accompany Paulmier's *Mémoires*, is described by M. d'Avezac as a stereographic projection enclosed in a rectangular border, surmounted by the title, *Typus orbis terrarum, description de la Terre universelle.* Within the triangular compartment between the two hemispheres and the upper line of the border is added this second title, *La mappemonde ou planisphère terrestre*; and in the lower compartment, *De Fer Excu. Avec Privilége du Roy.* It appears to have been completed on 1st December 1663, and is, with two or three corrections, a reproduction of a mappemonde published ten years previously in a small atlas entitled *Trésor des Cartes géographiques des principaux Estats de l'Univers*, by Louis Boisseuin, at Paris, 1653. M. d'Avezac

[1] See the Introduction, by Sir Clements R. Markham, to Robert Hues' *Treatise*, Hakluyt Edition, 1889, pp. xxvi., xxviii., xxx.

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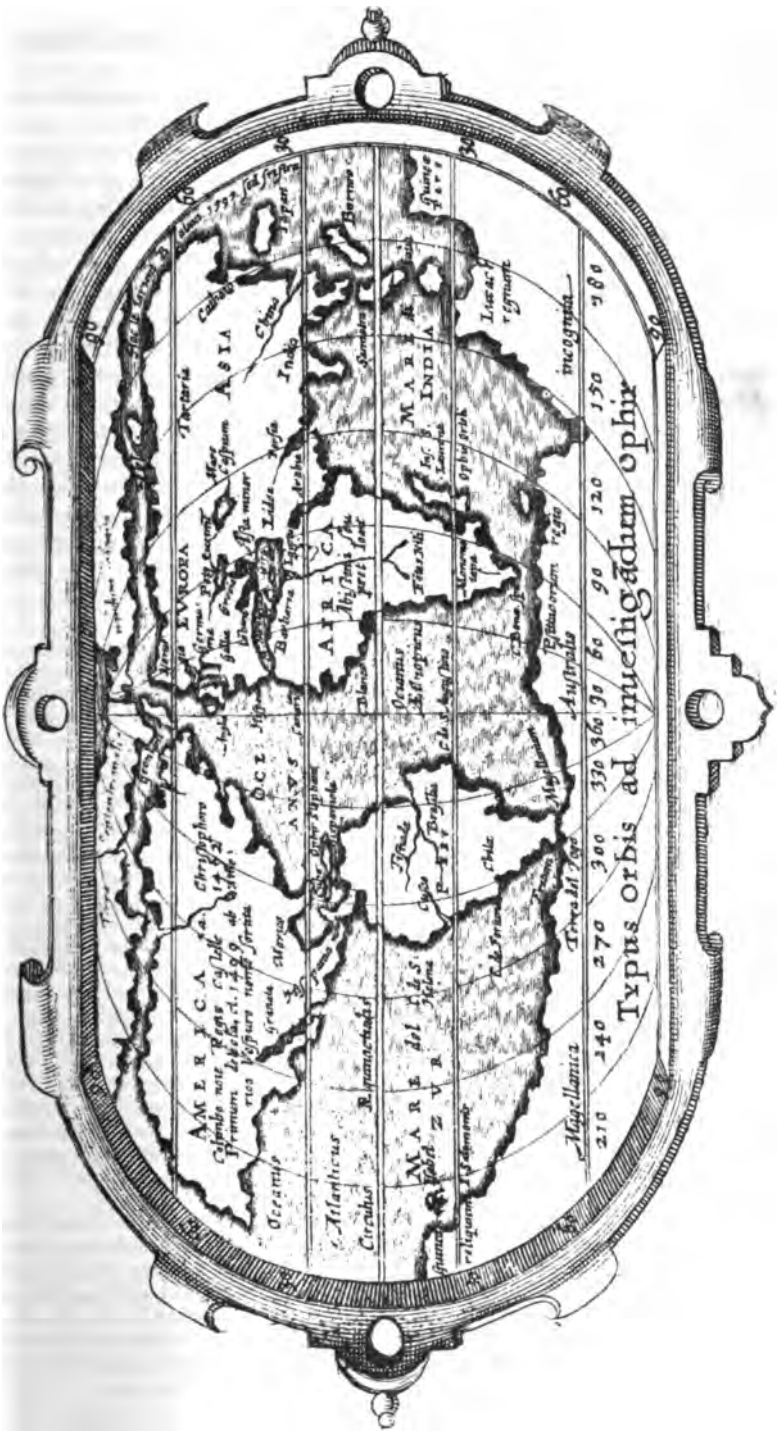

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states that this De Fer is probably Antoine de Fer and not Nicolas de Fer, the geographer.

Two maps, from the *Histoire universelle des Indes Orientales et Occidentales divisée en deux livres. Le premier par Cornille Wytfliet : le second par Ant. M. & autres historiens,* Douai, 1605,[1] have already been reproduced in Part I. of the present paper. The first, *Utriusque Hemispherii Delineatio,* shows the *Terra Australis* extending northwards beyond the Tropic of Capricorn as far as lat. 20° S., almost touching *Noua Guinea* in the western hemisphere, whilst in the eastern hemisphere part of the same southern continent reaches as far north as lat. 16°, in the form of a promontory between *Iaua maior* and *Iaua minor,* the coasts of this promontory bearing the names of *Beach, Maletur,* and *Lucach.* The second map, *Chica sive Patagonica et Australis Terra,* 1597, gives this same continent in greater detail. Within the Antarctic circle are marked rivers and mountains of *Terra incognita,* outside the circle the *Terra Australis* is shown, with the *Psittacorum regio* stretching along the latitudes of 50° to 45° opposite the *C. Bonæ Spei* and the *Ins. S. Laurentii ;* whilst between the two Iaua islands are the two kingdoms *Maletur regnum* and *Lucach regnum,* with *Beach* on the extremity towards *Iaua major.* On the upper portion of the same plate is shown on a large scale the *Australis terre pars,*

[1] The text referring to the Terra Australis, by Wytfliet, is but brief :—

"Mais pour retourner à nostre Amerique à cause de sa grandeur & son large pourpris, est prise pour la quatriesme partie de tout l'Vnivers selon la commune opinion des Cosmographes de nostre temps. Aucuns veulent adiouter la cinquiesme, ce que ie ne peus croire facilement ; car la terre Australe qui tend vers le septentrion, à bon droit se peut dire vne partie de l'Amerique, come non estãt separée sinon d'vn petit bras de la Mer Magellanique, & qui voudroit aller au contraire, faudroit qu'il feit encor vne autre partie de Lappelãde, Suede, Noruuege, Gotlande & Scanie, que ne sont mises en la description Septentrionale de Ptholomé, & puis vn autre des deux laues isles en la mer Orientale, bien que toutefois vn chacun les tient pour quelques parties ou de l'Asie ou de l'Europe. Pour estre le plus pertinent feroit la diuision qui departiroit l'Vnivers en trois parties, dont la premiere contiendroit toute l'Europe, l'Asie & l'Afrique, la secõde toute l'Amerique, qui s'estãde de l'vn à l'autre costé de l'Equinoxe ; & la troisiesme toute la terre Australe qui est enuironnée tout de mer, & ne se joinct à nulles terres, & n'est cest diuisiõ nullement contraire à l'autre cy dessus, qui est faite & proportionée selõ les departiments du ciel que posent & ordonnent les Astrologiens. Et croy si Ptholomée fut esté de nostre temps, ou biẽ qu'il eut eu telle cognoissance de l'Vniuers que nous auons maintenant, qu'il n'eut reprouué cette diuision ; attendu que lui mesme à departy ce qui estoit cognu de son temps, selon la separation des terres fermes, comme l'on peut veoir en l'antepenultiesme chap. de son liure 7. Au reste tout l'Hemisphere Occidentale est maintenant descouvert, sauf quelque parti qui tire vers le Midy : & se monstre vers le Midy en forme des deux Isles, separées seulement d'vn petit Istme ; dont l'vne sçauoir celle qui regarde vers le Septentrion contient la neuue Espagne, la province Mexicane, & beaucoup d'autres terres, autre qui tire de l'Equinoxe vers l'auton & a la forme d'vn cœur humain, contient le Peru, Bresil, Plata, Chica, & plusieurs autres provinces, & regarde la terre des papagaux, de laquelle elle n'est separée que la Mer Magellanique."—(*Op. cit.* pp. 69, 70.)

"*La Terre Ferme Australe et de Chica.*—Allant des dernieres cantons de l'Orient vers le Midy, la terre Australe se presente la premiere. . . . . La terre Australe doncq, la plus Australe d'entre toutes les autres qui est mise directement sous le cercle Antartique, & s'estend vers les terres Orientales, outre le tropique de Capricorne, se termine presque en l'Equinoxe mesme, et diuisée d'vn petit bras de l'Ocean, opposé à l'Orient la neuue Guinée, qui à bien peu de ses riuages cognuz, pour autant qu'apres quelques nauigations ceste route à este intermise, & que rarement y viennent les nauires, sinon contraintes & emportées par la tempeste."—(*Idem,* p. 71.)

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opposite to, but slightly apart from, *Chica sive Patagonum regio.* Indeed Wytfliet states that the *terre Australis* has a good right to be styled a part of America, as not being separated from it but by a small arm of the Magellanic Sea. In another paragraph he alludes to South America, stretching south from the Equator in the form of a human heart. It contains, he says, Peru, Bresil, Plata, Chica, and several other provinces, and faces *la terre des Papagaux.*

Another map is quoted by d'Avezac, on which the Australian continent is traced, viz., *Carte universelle en laquelle la Globe terrestre est entièrement réduite et représentée dans un seul cercle, etc., par Louis de Mayerne Turquet, 22 Juillet,* 1648, *corrigée en* 1661. On this is to be seen, between 70° and 75° longitude east from meridian of the Isle of Ferro, in 68° lat. south, *le Païs de Perroquets,* and further east, in long. 95°-98°, about 52° lat. S. is the *Païs d'Arosca* (*i.e.* of the king whose son was brought to France by Gonneville).

A planisphere or *Carte générale du Monde,* by Du Val, géographe du Roy, 1684, also indicates the *Terre des Perroquets.*

The famous globes of P. Vincent Coronelli, constructed in 1683 for Cardinal d'Estrées at Venise—now preserved in the Bibliothèque Nationale at Paris—are mentioned by d'Avezac as containing the lands marked *Terra de pappagalli detta da' Francesi Terre des Perroquets creduta favolosa.*

Le Globe terrestre par Coronelli, published by Nollin in Paris *circa* 1690, likewise contains the same Land of Parrots.

On a globe constructed in 1700 by the Royal Engineer Bion, directly south of Tristan d'Acunha, is to be found noted—"Gonneville a reconnu ces terres en 1503; il les nomma *les Indes méridionales.*" M. Léon Renard, the librarian at the Dépôt général des cartes et plans de la marine, found the sheets containing the projections, in 24 half gores, of this globe and another, dated 1700 to 1712, forming Nos. 37 and 38 vol. i. *des Mappemondes.* On both of these, at 42° S. lat. and 5° E. of Isle de Fer, is marked *Le Cap de Vue, ou de Terre Australe,* within the interior of which is inscribed, *Terre des Perroquets.*

We now come to the charts of the eighteenth century, amongst which may be mentioned the mappemonde of two hemispheres drawn by Guillaume De Lisle[1] revised and corrected by Buache[2] in 1766; and, lastly, that by our British geographer, Samuel Dunn,[3] entitled *Scientia terrarum et cœlorum, or the Heavens and Earth astronomically and geographically delineated and displayed,* London, 1779. In this is to be found *The Land of Parrots, or Gonneville's Land.* In the New and Correct Mapp of the World, Third Book of *The English Pilot,* by Samuel Thornton, hydro-

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[1] Guillaume Delisle or de Lisle, born at Paris, 1675, son of Claude Delisle, one of a family of geographers, constructed a mappemonde in 1700; the last edition of his mappemonde he published in 1724. He died in 1726.

[2] Philippe Buache, successor of Guillaume Delisle and predecessor of d'Anville in the Académie des Sciences, was born 1700, died 1773. His *Atlas physique* appeared in 1754.

[3] Samuel Dunn, a mathematical master at Crediton, was employed by the Hon. East India Company to examine their cadets. He died 1792.

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grapher, published in 1716, there is no reference to the Land of Parrots, but this chart does not show any portion of the globe above 58° S. lat., just including Cape Horn. It would be interesting to find if there is any reference to Gonneville's Land in Capt. Halley's notes during his voyage South.

By this time it had become apparent to hydrographers and map-makers that this so-called Land of Parrots was not to be looked for in any latitudes higher than those in which the Cape of Good Hope and Cape Horn are situated.

But meantime the several expeditions which had been despatched from time to time to search for this unknown country should be noticed at some length.

Lozier Bouvet.[1]

In 1738 the French Company of the Indies, excited by the discussions then prevailing on the possible existence of Gonneville's supposed Austral lands, fitted out an expedition to discover, if possible, to the south of Africa a land which might serve as a port of call for their ships, which would thus be rendered independent of the Dutch settlement at the Cape. Otherwise the directors of the Company supposed that the lands of Arosca must be in Madagascar. Accordingly Captains Lozier Bouvet and Hay were despatched from L'Orient on the 19th July 1738, in command of the frigates *l'Aigle* and *la Marie*, to search for land in 44° S. lat. and about long. 355° of the French meridian. After re-victualling at the Isle S^ta^ Catherina, on the coast of Brazil, they began their voyage of discovery on the 26th November, by which date they encountered the heavy southern fogs in lat. 35° long. 344°. During the first week of December (lat. 39° to lat. 44°, between long. 350° and 355°) they continually met with those immense seaweeds which cause such obstacles to navigation in those Antarctic regions, until, on the 10th December, they found themselves at the spot where their charts showed a supposed land, named *Terre de Vue* or *Cape des terres Australes*, at the intersection of the parallel of 44° with the first meridian of Paris.

Nevertheless, no land was visible until the 15th December, when in lat. 48° icebergs were seen, so extensive and of such height that when the fogs lifted they seemed to the navigators like islands, cliffs, and the battlements of fortresses. The magnetic needles here also varied continually of the compasses of the two ships, differing one from the other. At last, on the 1st January 1739, high land was discovered, to which Lozier Bouvet gave the name *Cap de la Circoncision*, in honour

[1] Jean Baptiste Charles Bouvet de Lozier, born 1706, member of a noble family of Brittany, is more generally known as de Lozier-Bouvet. He entered the navy in 1722, and was always desirous of exploring the Southern Seas, which presented a wide blank on the mappemondes of that period. In 1731 he was a lieutenant of one of the French East India Company's ships. After his voyage of 1738-39 he was promoted Capitaine de frégate in 1746, and was in the division destroyed by Admiral Anson, 1747. In 1750 he became Governor of Bourbon. In 1774 he was ennobled, and received a pension. The date of his death is not mentioned. His life has been written by M. Eugène Fabre, and a notice of his biography, by M. Adrien d'Epinay, was published in Mauritius, 1890.

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of the feast day. Its position was estimated to be in 54° lat., between 27° and 28° of longitude. The coast was steep-to, inaccessible, and covered with ice—surrounded with small islets, or huge masses of pure ice of two or three leagues in circumference. The vessels coasted along these shores for twelve days, but were unable to find any accessible points for landing. Then continuing to sail east until the 25th January until lat. 57° was reached, when they turned north-east, as Gonneville's lands were said to lie in the same latitudes as the provinces of France. Again the immense drifts of seaweed were met with until the 43° parallel was attained. There the two vessels separated, the *Aigle* making for Isle Bourbon, whilst the *Marie*, returning by the Cape of Good Hope, anchored at L'Orient on the 24th June 1739.[1] It was very evident that these lands of Bouvet [2] could not be those pleasant shores depicted by the descendants of Gonneville.

De Fréville.

Captain Flinders, as we have already stated, expressed his belief that Gonneville's ship had been cast on the shores of Madagascar. He was not the only one who held this opinion, for previously, M. de Fréville, in the preface to his history of new discoveries made in the South Sea, published in 1774 at Paris, had expressed himself as follows:—

"The glory of the first discovery in the Australian regions is attributed to a Norman, Paulmier de Gonneville, in a navigation undertaken in 1503. He sailed from Honfleur in a single vessel, which some merchants had fitted out for the East Indies. After having doubled the Cape of Good Hope, he was surprised by a violent tempest which caused him to loose his reckoning and cast him on a coast, which they assert formed part of a continent. At first this land was said to be placed between Africa and America, about the forty-second degree of latitude and the seventh of longitude; and latterly to the south-west of the Cape of Good Hope in forty-eight degrees of latitude and twenty of longitude, under the name of *Terre de Gonneville* or *Terre des Perroquets*, because these birds were in great numbers on the shore where he had landed.

"The relation of Gonneville tells us that he found on the continent where he was cast a fertile country with people disciplined and submissive to a king, of whom he brought into France a son named Essomeric.

"Nevertheless all the navigators who have crossed the ocean between Africa and America have never perceived this supposed Land of Parrots, nor any other at this high latitude which by its extent could deserve this name; it is even known that all the lands which have been met with in these seas are situated between the fiftieth and sixtieth degrees of

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[1] Vide *Les Navigateurs Français. Histoire des Navigations Découvertes et Colonisations Français*, par Léon Guérin. Paris, 1847, p. 510 *et seq.*

[2] The German Government fitted out, in 1898, the large Hamburg-America liner *Valdivia*, under the scientific leadership of Professor Chun of Leipzig, for Antarctic exploration. The *Valdivia* left Hamburg August 1898, left Cape Town in November, and re-discovered Bouvet Island in the South Atlantic, steaming subsequently 1800 miles eastward along the edge of the Antarctic ice-peak, reaching 64° 14′ S., off Enderby Land (Hugh Robert Mill.).

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latitude. The rigour of these climates, the ice and excessive cold which reign there, agree but badly with the beauty, the productions and the manners of the country spoken of by Gonneville, and make of the Land of Parrots an imaginary story.

"If attention be given to what Gonneville has said, that he did not find this land until after he had doubled the Cape of Good Hope, it will appear very probable that the navigator came to shore on the island of Madagascar, which the Portuguese had already met with. It is to this island alone that his vague narrative can indicate, transmitted by tradition, and published more than an hundred and fifty years after his return to France."[1]

KERGUELEN.

M. de Kerguelen[2] conceived the project of making a voyage of discovery in the Antarctic seas in 1770, but the then Minister of Marine, César Gabriel de Choiseul, Duc de Praslin, was too busily engaged in fitting out a fleet of warships at Brest to attend to such matters of minor importance, and Kerguelen was nominated to command the frigate *la Renommé* in case of war. But as soon as affairs were regulated with the court of England, Kerguelen again approached the Abbé Terray, who had, meantime, succeeded to the Duc de Praslin, and this time with better success, for he was appointed to the *Berrier*, which was taking out reinforcements to the Isle of France. The instructions to Kerguelen contained, amongst other matters, the following paragraph :—

"The Sieur de Kerguelen is instructed that there is every reason to suppose that a very large continent exists to the South of the islands of Saint Paul and Amsterdam, & which probably occupies a part of the globe from 45 degrees of South latitude up to the neighbourhood of the pole, over an immense space where no one has yet penetrated. It appears sufficiently certain that the Sieur Gonneville touched there about the year 1504, and stayed there nearly six months, during which time he was considerately treated by the people of the country. The Sieur de Kerguelen, on leaving the Isle of France with the corvette which will be given him for the purposes of discovery, will make sail towards these lands. He will make every effort to find and to survey them. Should he happen to discover them, he will try to find a port where he can obtain shelter. He will take all necessary precautions to land with safety. He will try to enter into commerce and friendship with the natives. He will examine the resources of the country, its productions, manufactures, if there are any, and what among them may be useful for the trade of the kingdom. . . ." The instructions given to Kerguelen were dated March 25, 1771.

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[1] *Histoire des nouvelles découvertes faites dans la Mer du Sud en* 1767, 1768, 1769, 1770, rédigée d'après les dernières relations par M. de Fréville, 2 vols. Paris, 1774.

[2] Ives Joseph de Kerguelen Tremarec was born in Brittany 1745, and entering the French navy as a boy, became lieutenant in 1767, when he was sent to Iceland for the protection of the French fishermen. After the voyages above recorded he fell into disgrace, but subsequent to the revolution became an admiral. He died 1797.

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The Abbé Rochon[1] was sent by the minister to accompany Kerguelen as astronomer, to determine the positions of the various localities visited.

M. de Kerguelen carried out his instructions implicitly, although the Abbé Rochon did not accompany him after reaching the Isle of France. In place of this expert, M. Kerguelen took with him an adventurous and intrepid soldier, Captain O'Connell, who was at that time Captain Aide Major of Clare's famous regiment in the Irish Brigade, which had landed in Port Louis in the preceding year. It is not generally known that an Irishman accompanied Kerguelen on this expedition.[2]

In January 1772 Kerguelen started on his voyage of discovery in the corvette (flûte) *La Fortune*, in company with the vessel under M. de Saint Allouarn, and we give his own reflections on the prospect of finding Gonneville's supposed Land of Parrots. He says :—

"I directed my course, on leaving the Isle of France, as directly as possible to the South, and these are the motives which impelled me. I thought that if I was lucky enough to discover lands in this direction, they would be those least distant from the Isle of France, and consequently they would be more useful to that Colony. I reflected that the good season had passed, and that we must take the shortest way. Moreover, the tradition, which instructed us concerning the voyage of M. de Gonneville, and of his supposed stay in Austral shores, informed us, at the same time, that a cyclone which attacked him after having doubled the Cape of Good Hope, whilst going to India, cast him on a coast or shore where he safely landed, and where he was well received by the inhabitants. Indeed, if we give credence to this tradition, of which subsequently a narrative has been made, and if we wish to form some conjecture on these reported Austral lands, we must suppose this where M. de Gonneville landed in the South-east of the Cape of Good Hope, or the South of the Isle of France, since storms and strong winds always blow from the north-west in this portion of the globe. On account of these reflections, I made my course to the South of the Isle of France."

As is well known, the distinguished French navigator discovered the land which he named Isle de Kerguelen (in 49° 40′ lat. S., 61° 10′ long. E. from Paris), where M. de Boisguehennen, second captain of the *Gros Ventre*, deposited a bottle, containing the act of taking possession in the

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[1] Rochon gives these instructions at length, and recounts de Brosses' narrative, but adds :—"No one can have any reasonable doubt as to the existence of the lands found by Captain Gonneville; but it must be agreed that on such vague information, as I have just given, it would be impossible to form any hope of finding them; as I observed to Captain Kerguelen, as soon as I knew the nature of his mission."—(*Voyages aux Indes Orientales*, tom. iii. p. 210).

[2] In Mrs. Morgan O'Connell's biography of Count O'Connell, *The Last Colonel of the Irish Brigade, Count O'Connell; and Old Irish Life at Home and Abroad*, 1745-1833, 2 vols. (Kegan Paul, Trench, Trübner and Co., 1892), pp. 154, 155, it is related how Captain O'Connell proceeded with his regiment to the Isle of France, which he reached on July 10th, 1771. Shortly after he got back to France, in 1773, he wrote to his brother :—"The officer of the navy, with whom I made the South Sea Discovery, is gone out a second time to that part of the world with three ships, the one of which is a 64. He wrote to me to propose me that journey. He was gone before I arrived here, where I found his letter." "What did they discover?" asks Mrs. O'Connell. "Whatever it was we shall never know." I first drew attention to O'Connell's connection with Kerguelen's discoveries in the pages of the *Athenæum*.

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name of the King of France, with all requisite formalities. This bottle, it may be remembered, was subsequently found by Captain Cook, in his third voyage, on Christmas day, 1776.

Kerguelen's ships were separated, and he returned alone to Port Louis by the 16th March.

The conclusion at which Kerguelen arrived regarding Gonneville's lands, after his two voyages to the South Seas, is summed up by the French explorer thus :—

"Concerning the voyage of M. Gonneville, and his stay in a supposed Austral land, this is my opinion in four words. 'The tradition teaches us that after having passed the Cape of Good Hope to go to the Indies, he was assailed by a storm; that being deprived of all his masts, by chance he met with a land, where he coasted; that he entered into a river, which he compares to that which flows under the walls of Caen in Normandy; that he found on the coast some inhabitants by whom he was well received; that the Indians, with whom he stayed, loved good cheer and to lead a joyous life; that the king with whom he was was called Arosca; that he was at war with another king; that the Indians were all naked, and especially the children; that they made matting and other stuffs artistically worked, etc.' Indeed, all this applies perfectly to Madagascar, and cannot be applied to any other southern lands, for it is not possible to dispense with clothing even in 35 degrees south latitude; and we know that absolutely there are no lands beyond the Cape of Good Hope less South than 50 degrees. Besides, the good cheer, the joyous life of the hosts of M. de Gonneville, and which he names Indians; their customs not to be clothed, their handiwork, their feathers, their mats, their wars, etc., all indicate that M. de Gonneville had landed on the Island of Madagascar. The timber which he found for remasting his vessel, and which is not to be found on the Austral islands, not even at the extremity of Africa, confirm my opinion. The very name of the king, with whom he lived, serves me with additional proof, for he was named Arosca, and the names of the islanders of Madagascar are terminated ordinarily in *a*. I have known, in my last voyage, some chiefs or kings in that island, who were named Revola, Caletta, and Ibita. One of my officers, M. de Karnelle, passed six days with this last-named, to procure oxen for my crew. In short, I firmly believe that the Austral land, where M. de Gonneville touched in 1503, is the Island of Madagascar, which was only rediscovered in 1506 by the Portuguese."

M. DE PAGÈS.[1]

In the last year of the reign of Louis XV., after the disgrace of the great minister de Choiseul, the Minister of Marine, Pierre Etienne Bourgeois de Boyne, ordered two ships, *Le Roland* (64 guns), commanded

[1] M. le Chevalier de Ligniville afterwards speaks of Lieutenant de Pagès, in 1775, as "l'imbecille Pagès, qui est sue le grabat, attribuant sa situation aux terres australes plutôt qu'à ses débauches de Madagascar." De Pagès, becoming a captain, was murdered during the revolt of the slaves at St. Domingo in 1793.

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by Kerguelen, and *L'Oiseau*, a frigate, commanded by Captain Rosnevet, to visit the South Seas on a voyage of discovery to find the "*terre promise*" of Gonneville. A certain Lieutenant de Pagès was attached to the *Roland* by M. de Boyne, as naturalist, and, as it appeared later, to act as a spy upon Captain Kerguelen.

This expedition reached the Isle of France on the 29th August 1773, when a corvette was fitted out to accompany the expedition, being more suitable by its light draught to approach unknown lands.

M. de Pagès subsequently published an account of this voyage, and we are enabled from his pages to enter into the views by which the expedition was guided.[1] He writes:—

"I will here report the several narratives which caused us to suspect the existence of Austral lands, and the plan of our route in order to discover them. Captain Paulmier de Gonneville, wishing to double the Cape of Good Hope, had met with a terrible hurricane. Being obliged by the bad weather and by the damage of his ship to yield to the tempest, he found himself near a land, where he anchored. He entered for repairs into a river which he depicts as the size of the Seine [Orne ?]. Here he found the inhabitants mild and friendly, who had clothes made of matting or feathers. The children often went naked. The country abounded in food, and had several kings, who made war with one another. . . ."

M. de Pagès then alludes to former voyages to discover Gonneville's Land, and continues:—

"These two recent voyages,[1] and those of ships which have run to the South in doubling Cape Horn, demonstrate that, if there exists an Austral continent, that part of it which faces the ocean must have a latitude higher than fifty degrees. They demonstrate also that the portion of this Continent which fronts the Indian Ocean must have a latitude at least higher than forty-seven degrees. Regarding this part of the same continent which abuts on the Pacific Ocean we have no knowledge. The Charts nevertheless mark a land discovered by Drake to the West-south-west of Cape Horn, and consequently in a higher latitude than these two parts.

"These voyages also demonstrate that if the land where M. de Gonneville landed was to the South of the Cape of Good Hope, it could only be an island situated to the South-east or East-south-east of this Cape. We doubt of the existence of this land to the South of the Cape, for the circumstances reported in the narrative agree but little with inhabitants of such a land; on the other hand they do agree with the inhabitants of Madagascar. The kings there are continually at war. The natives are dressed in mats, and very gay; the children run naked; the birds have beautiful plumage. There are at the south of the island rivers sufficiently large to receive the ship of M. de Gonneville; there are frequently violent hurricanes off the coast and at the opening of the [Mozambique]

[1] *Voyages au tour du monde et vers les deux poles, par terre et par mer, penchant les années* 1767, 1768, 1769, 1770, 1771, 1773, 1774, and 1776. Par M. de Pagès, Capitaine des Vaisseaux du Roi, Chevalier de l'Ordre Royal and Militaire de Saint-Louis, Correspondant de l'Académie des Sciences de Paris. Paris, 1782. Tome ii., pp. 49 *et seq.*

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Channel; and the great age of M. de Gonneville's narrative has doubtless led to its being misinterpreted or mutilated, where it states that he had been knocked about by the storm in doubling the Cape of Good Hope. If, nevertheless, should this circumstance be true, it would appear that the land which he reached was in a higher latitude than the Cape, since the violent winds of these regions are nearly always from the North or North-west. It would at the same time be probable that it could not be in a much higher latitude, since the inhabitants had garments of matting and the children ran about naked. It could, therefore, only be in the South-east or East-south-east, for, if it had been directly to the South, it must have been discovered by the East Indiamen, which, in order to escape the storms at this point of Africa, often kept as far South as the fortieth degree of latitude.

"We believed, then, that it was necessary to sail towards the South-west, to attain the thirty-eighth or fortieth degree of latitude, at the same time as the thirty-seventh or thirty-fifth degree of longitude, and we considered it likely to find in these seas the lands of M. de Gonneville. They must, necessarily, be of some extent since they were divided between several kings. In the case of not finding them there, we intended to join the fiftieth degree of latitude as nearly as possible at the point where the *Aigle* and the *Marie* had ceased to run to the East on this parallel, and we were to continue to sail towards the East. We hoped to discover on this course several portions of the supposed continent."

Marion Dufresne.

Captain Marion Dufresne was commissioned by the then Minister of Marine, M. de Boyne, in 1771, to convey the Tahitian, Aotourou, back to the Isle of France; and Marion offered to take this South-Sea islander at his own expense from Port Louis to Tahiti. For this purpose Captain Marion fitted out two vessels, viz., the *Mascarin*, which he himself commanded, and the *Marquis de Castries*, navigated by Chevalier Duclesmeur. Lieut. Crozet was engaged at the Ile de France as second in command of the *Mascarin*, and it is his narrative that gives us details of Marion's voyage and the tragedy by which Marion lost his life in New Zealand. Aotourou died at the moment of leaving the French colony. "It was proposed that he should advance sufficiently to the south in order to try to discover there the islands or continent which it was supposed were to be found in this southern portion of our globe. The Intendant[1] of the Isles of France and Bourbon was especially desirous that the most northerly portion of this supposed land should be discovered, as it would be nearest to the colonies and under a more temperate climate." The ships having been provisioned at the Cape of Good Hope, sailed from Table Bay on the 28th December 1771, and M. Marion directed his course towards the South in order to discover the outhern lands of Gonneville. This voyage led to the discovery of the

[1] This Intendant was M. Pierre Poivre, the most enlightened of all the Intendants ever sent to manage the affairs of the Mascarene Islands.

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Marion Islands[1] in lat. 46° 53′ S., long. 37° 33′ E. (Greenwich), and the Crozet Islands,[2] after which discoveries the *Mascarin* and her consort proceeded East to Van Dieman's Land.

This seems to have been the last practical attempt to discover the much-vexed land of Gonneville, and henceforth, says M. d'Avezac, geographers alone occupied themselves with the solution of this problem from an historical and geographical point of view.

Among these writers Jean-Benjamin de la Borde published, in his *Histoire abrégée de la Mer du Sud*, 1791, his opinion that Gonneville's Land ought to be found between the latitudes 50° and 60° south, near New Zealand. The Président, De Brosses, has already been mentioned. Captain James Burney, in 1803, favoured the Malagasian theory, and upheld this view in his later volume of 1813. The geographer Eyriès also adopted this theory in his notice of Gonneville in the *Biographie Universelle*; so did M. León Guérin in his *Histoire maritime de France* in 1847.

The Madagascar theory, however, did not find favour in the sight of M. Louis Etancelin, who reproduced the accounts of Abbé Paulmier and the arguments of M. de Brosses, but objected to the conclusions arrived at by these authors in his *Recherches sur les voyages et découvertes des navigateurs normands*, 1832. Whilst M. Commissaire Thomas in his *Histoire de la ville de Honfleur*, 1840, where he gives a sketch of Gonneville's expedition, declared that Paulmier's account could not apply to any place or people, whether New Holland or Madagascar. After all, he is probably right in his conjecture.

In 1847 M. Pierre Margry, the accomplished historian, who was then attached to the Government department of the Archives in Paris, whilst engaged in examining documents for the *Collection officialle des documents inédits sur l'Histoire de France*, found a certain *dossier*, in which was contained apparently an entire copy of the famous declaration made by Gonneville on his return from his voyage in 1505, seemingly addressed, with other letters, to the Maréchal de Castries and the Comte de la Luzerne by a certain Baron de Gonneville. This claimant of a pension had offered the Maréchal de Castries to go and find at the manor of Gonneville, which had passed into other hands, the account of the voyage of his ancestor, which could not be found in the records of the Admiralty. This document, afterwards sent to the Minister as a complete copy, turned out however to be simply a copy, by the hand of a hired copyist, of the book of Abbé Paulmier so far as the extract of the original account, therein contained, together with a restoration of certain initial pages containing the report of the navigation from the leaving Honfleur up to the arrival at the unknown country, together with a final addition of signatures, both these new portions being in the handwriting of the aforesaid Baron de Gonneville. In this newly discovered document for

[1] One of these islands, the westernmost, was named by Marion *Terre d'Esperance* in the hope that it might prove to be an outlying portion of the great southern continent for which he was in search.

[2] Crozet islands, between lat. 45° 56′ and 46° 26′, long. 50° 10′ and 51° 39′ E. of Greenwich.

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the first time appears the name of Brazil as that of one of the countries visited by Gonneville on his return voyage.[1]

NORTHERN NYASALAND.

By the Rev. JAMES HENDERSON.

HAVING occasion to make several journeys through different districts of the territory lying to the west of the northern half of Lake Nyasa in British Central Africa between the years 1895 and 1899, and finding the maps which I took with me for my guidance altogether deficient in detail, I acquired the habit of collecting information by the way to supplement them for my own guidance. I had no ulterior purpose in doing this until towards the end of that period, when, being asked to prepare for publication in a local periodical the route-map and the notes of another member of our service who had undertaken an exploratory tour across the head waters of the Loangwa, I began to realise how much material there was at hand from a number of sources for a comparatively full and complete new map of the whole district. My personal knowledge being restricted to the section west of the northern half of Lake Nyasa, the following notes refer only to it.

This tract of country divides itself naturally according to elevation into three belts, running more or less parallel to the lake, viz. the coast with the plains that extend back from it, only a few feet above its level; then the "first" or Tumbuka plateau ascending out of these plains and from the water's edge; and lastly the "second" or Nyika plateau, which for the greater part of its extent rises from this "first" plateau and partly from the lake shore plain. Between the two plateaus there is a difference in elevation of about 2000 feet.

The appearance of this country is exceedingly wild and rugged. Unlike the country to the west of the southern half of Lake Nyasa, which is mostly plain flanked at a distance only by hills, on the northern half, for the greater part of its length, that is from Mount Nkwazi, north of Chintechi on to Mount Waller in the south of Florence bay, the skirts of the mountains go sheer down into the water with hardly anywhere even the vestige of a beach. The only exceptions to this general statement occur at Usisya, where there is a plain more than a mile broad, at Nkata and Ruarwe, where there are small land-locked bays with a narrow strip of land between their enclosing heights and the water, and at the deltas formed by the Rukuru and Rumpi rivers. The small land-locked bay of Toto has no beach at all, the cliffs going straight down into very deep water, and on my last visit to it I found that the village, which was formerly hanging like a row of swallows' nests upon its northern cliff, had been entirely swept away by a landslip. The islands off the coast are mere masses of great bare broken rocks, insigni-

[1] M. Margry published the whole of this document, *in extenso*, in his *Navigations françaises*, 1867, pp. 160-162.

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ficant in their entirety. Once covered with huts, they are now deserted, and some of them with the falling of the lake level are becoming connected with the land. Northwards and southwards of the points named the hills recede from the coast, leaving plains which gradually extend in breadth towards the north and the south.

The products of the native gardens in the coast plains and on the lower slopes are cassava, sweet potatoes, ground nuts, several kinds of millet, maize, beans, pumpkins, tobacco, bananas, and plantains; as well as, where external influences have been felt, rice, lemons, pine-apples, papaus, custard apples, and mangoes. A kind of hemp is grown by the fishermen for making nets, and in the swampy plains a pith tree called *Mabingwe* is found, which yields a substance nearly as light as cork, used for floats. In the neighbourhood of Bandawe the wild arrow-root plant is plentiful. The Konde people around Karonga ornament their villages with rows of cotton-trees. Between the mouth of the Dwambazi river in the south and Lion Point in the north there are practically no palm-trees, but beyond these points the *borassus* and *raphia* palms occur in clumps often covering a large area. Cacti of any size are rarely met with in this belt, and the euphorbia is also absent, but the baobab, and still more the acacia, is prevalent. The quality of the soil, except where it is alluvial, is poor, and where it has been long continuously under cultivation, as in the Usisya Plain, it appears to be quite exhausted.

Until four or five years ago sheep and goats were the only food animals kept on the lake shore except at Karonga, where cattle were always abundant, but since then cattle have been successfully introduced into most of the villages. There is little doubt that with the practical disappearance of the buffalo, owing to the rinderpest, the tsetse-fly has also been got rid of from districts that were formerly infested.

With game this belt is not very well stocked. The only antelopes to be found along its whole extent are water buck, reed buck, bush buck, and duiker. Hartbeest, koodoo, eland, and clipspringer are to be met with at certain places and times. Small troops of zebra appear in the Hara plain after the grass is burned. Herds of half a dozen buffalo or less occasionally descend the slopes during the rains. Elephants are probably never altogether absent from the swamps behind Chintechi. A rhinoceros is reported now and then from the Fulirwa plain. Large herds of antelope are to be found all the year round among the swamps of the Bana plain and the palm and other forests that surround it. There and around Domira bay, farther south, are the favourite haunts of the hippopotamus, which is somewhat rapidly disappearing owing to the destruction of it by Europeans because of its danger to boats and canoes and the harm it works in native gardens. Lions are numerous in the Bana, Chintechi, and Fulirwa plains. Leopards, jackals, and hyenas exist all along the coast. Packs of wild dogs are not so rare as has been supposed. Otters are captured beside the streams. All the large rivers and some parts of the lake are frequented by crocodiles. Wild fowls are remarkably scarce. Except in two or three of the marshes ducks and geese are rarely seen. The only birds to be found everywhere

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along the coast are the small sand-plover, the kingfisher, and the screaming fish-eagle.

The prevailing character of the rock is igneous, except at Mount Waller and along the coast in the direction of Deep Bay, where there is a formation of sandstone and limestone. Mount Waller, an almost perfect plateau, less than a mile in breadth, with bare weathered faces rising out of foothills, precipitous declivities, screes, and nearly perpendicular cliffs, looks down upon the lake from an elevation of over 2500 feet above it. Formed of sandstone, it is the eastern extremity of what appears to be the upthrust of an old lake-bed, which, extending in a line to the west, ends, so far as my knowledge goes, in the wall-like western face of the Nyika plateau. Its strata are inclined at a low angle to the south-west, dipping into the Rumpi river. Around the base of Mount Waller the wash of the waves throws up at some places a black sand which appears to be coal detritus, and in the first third of the ascent of the north-eastern and south-eastern faces there is an outcrop of coal. At a lower level than where the coal outcrop appears there issues from seams in the rock a flow of hot water, forming a stream some three and a half feet broad by six inches deep. This water tastes somewhat sulphurous, but not unpleasantly, and forms on its banks a salt deposit which is used by the natives of the neighbourhood in cooking. North of Mount Waller, the Chitimba, Hara, and Fulirwa plains all give indications of the presence of lime, and in the last of the three workable limestone has been discovered at the head of the Hungerawi stream. This limestone occurs in deposits eight to ten feet deep, lying upon a soft, pinkish sandstone, at the summits of small, steep, sugar-loaf-shaped hills that are dotted in large numbers over a stretch of country rich in good timber. Lion Point, which separates Florence bay from Young bay, presents, at the water's edge, a yellowish white face of soft rock, which has been hollowed out by the action of the waves and by weathering. It contains a number of small caves and grottoes. Some of these are covered with crude representations in charcoal of native pictorial art, showing figures of men and animals in Egyptian-like profile, some stationary, others in motion. Around Young bay on its north side pumice-stone is common in the sand.

Leaving now the lake shore and its plains, we find a succession of foothills, slopes, and cliffs, covered with trees, ascending to what from the foot appears to be a mountain ridge somewhere about 2000 feet above the lake level. The forest covering of the slopes contains much useful timber. It seems to be the secondary growth following upon a comparatively remote destruction of the primeval forest. From a kind of vine which has been found in the water-courses, large quantities of rubber have been extracted during the last three years. The slopes are generally uncultivated, but about half-way up the heights behind Bandawe two coffee plantations have been recently formed, one of them on a large scale, which, I understand, give fair promise. Near the summit the growth of wood is thinner. The trees are covered with trailing grey lichens and mosses, and in many places consist entirely of scrub, resinous trees, and the fruit-bearing scrub locally known as *masuku*. When,

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however, the sky-line is gained, what appeared to be a mountain range is found to be only the tilted-up edge of an exceedingly rough terrace plateau, to which the name Tumbuka may be given from its inhabitants.

The Tumbuka plateau terminates on the north in Mount Waller, and the precipitous cliffs that join that mountain with the base of Nymkoa mountain at the Manchewi and Kazichi Falls. Southwards, it declines on the west towards the foot of what seems to be a still loftier range, where the basin of its river system is seen running north and south. Thus it happens that, generally speaking, the headwaters on the Tumbuka plateau flow to some quarter of the west, while its rivers in their main course flow more or less north or south, only at their end cutting straight east through their watershed to the lake. The southern extension of this plateau is known as the Vipsya. But while partaking of the same character as its northern extremity, the Vipsya, instead of being shut in upon the west by mountains, there descends and dies away into plains. The basin of the Kasitu spreads out from its junction with the Rukuru in a fan-shaped plain towards the south and the west, and the basin of the Rukuru from its upper marsh, at a higher elevation, and farther south and west, extends in like manner and direction back to the watershed between it and the Loangwa river. These plains form the country of the Ngoni, under Mbalekelwa, the successor of Mombera.

The northern section of the Tumbuka plateau consists mostly of rolling selvas well watered and fairly fertile. The highest peaks bear dwindling tufts of primeval forests surrounded by a dense growth of bracken and grass interwoven with brambles and other thorny creepers. These peaks rise out of bare grass lands, which separate the ancient forest from the new. Below the grass lands, the forest that prevails is of poor quality except in the hollows, much of it being of the same nature as we found upon the upper slopes. The sub-soil is mostly a bright red clay very sparsely intermingled with sand and pebbles. Upon this there lies a dark loam varying in depth according to position, richest in the *dambos* where the wash-down of decayed vegetation and the charcoal from the grass fires is deposited. The inhabitants, who are of the Tumbuka, Henga, and to some small extent Poka tribes, show some skill in agriculture, cultivating successfully all the crops in common use on the lake shore. At the mission station in the Manchewi basin at 4050 feet above sea-level, experiments have been made with foreign crops, plants, and trees with encouraging results. Wheat yields a fair return. Oats on one trial failed. Coffee is promising. Fruit-trees and European potatoes and vegetables have been a moderate success. The white ants have destroyed the blue gum-trees, but the Mlanje cedars and the mahogany-trees are not attacked and thrive well.

The Vipsya has the same characteristics as this section of the Tumbuka plateau, but practically none of its land is under cultivation.

The plains which form the Ngoni country are for the most part arid and sandy, covered, where not under cultivation, by thin grass and miserable stunted bush. Once, no doubt, the land was well wooded and fertile, but the best timber was destroyed to make charcoal for the cultivation

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of the *maweri* millet, and the resulting denudation of the soil has ruined the rainfall. The clouds, laden with moisture from the lake, float low over the Vipsya, discharging the rain which keeps the Lunyangwa continually flowing; but reaching the hot, treeless, naked flats of the Ngoni country, they rise again and sail away to the far west, often without discharging a single shower. By the end of the "dry" season the ground is as hard as adamant, and the ashes left by the grass fires, which would in the ordinary course have done something to recuperate it, finding no lodgment on the surface, are washed away by the first rains to the lower and damper levels. All over the plains are scattered earth tumuli, varying in height from ten to twenty feet, often covered with euphorbia and scrub acacia-trees, now structureless, the creations apparently of a species of termite that has been extinct for ages. A broken chain of rocky hills, of a striking appearance from a distance, girdles the lower basin of the Lunyangwa, and runs along the east side of the Kasitu basin. Of these the most notable are Hora hill, Bwabwa, and Jenjewi. Hora hill is memorable as the scene of the massacre by the Ngoni of their revolted Tumbuka slaves, whose bleaching bones whiten its summit to this day. The Ngoni, having been in the habit of depending for sustenance upon the produce of their herds until the coming of the rinderpest, and upon the loot of their raiding parties, possess neither much skill in nor inclination for agricultural work. Most of it falls to the women and the slaves. The principal crops are maize and the obnoxious *maweri* millet. Since the ravages of the locusts have become annual, necessitating a root crop as a regular stand-by, cassava is also being largely grown. The *borassus* palm is met with in some numbers on the Kasitu river, near its junction with the Rukuru, and it spreads out into large forests in the upper Rukuru marsh. The fruit of this palm is used as food in seasons of scarcity. Within the last two or three years, the failure of the rivers, compelling the people to subsist at the end of the "dry" season on the loathsome milky white water of the wells, the shrinking of the rainfall and the exhaustion of the soil, have been leading many villages to migrate. This movement has been mostly to the south along the Mzimba river. There the people are occupying an uninhabited region, magnificently wooded, well watered, fertile, and stocked with game—by all accounts a veritable "land of Goshen."

The whole of this Tumbuka plateau appears to be free from the tsetse-fly. Cattle do well at both extremities of it, and have been frequently driven across the intervening uninhabited space without suffering harm. Horses have not been used on it. As regards game, the animals referred to as occasionally visiting the shore of the lake make here their proper home. The Henga plain is second only to the Bana plain in the number and variety of its *ferœ naturœ*, while the upper marsh of the Rukuru is without rival, in my knowledge, for the quantity of its wild fowl. This river harbours large numbers of hippopotami, and in some parts it is infested with dangerous crocodiles of immense size. The Ruhewi Plain is, according to local report, still well stocked with elephants. The Kasitu marsh is the home of the golden-crested crane and the maribou stork. Francolin and Knoraan are found in the open veldt,

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guinea-fowl and quails in the deserted gardens, snipe and plover on the uplands. But of game generally, and of birds specially, it is to be said that nowhere is there a great abundance. The herds that were depleted by the rinderpest are to some extent filling up again, but birds, although they suffered no such destruction by disease, are remarkably scarce. Snakes are not very common, and though I have known many cases of snake-bite, I am aware of only one fatal result occurring during my stay in the country.

The Tumbuka and Henga tribes are skilled in the smelting and working of iron. Their ruined furnaces, spread over a wide area in surprising numbers, give evidence both of the general prevalence of iron ore and of the extent to which the working of it was carried on in the past.

Passing on, now we come to consider the mountain range which we saw in rear of the northern section of the Tumbuka plateau, to which the name Nyika is generally applied. Nyika is not a proper name as used by the natives. It is simply "the uplands," and in that sense it is in very common use. Tanganyika, I venture to think, is nothing more or less than "Nyanja ya Nyika," the lake of the uplands. The plateau with which it has been particularly connected has, however, a special claim to the designation as *par excellence* the uplands of that country, rising as it does out of and towering above the main plateau lying between Lake Nyasa and the Loangwa river. In the few references to it occurring in papers on the geography of this country it is assumed, tacitly but incorrectly, that the Nyika plateau merges in the west into the lower plateau out of which it sprang. But in reality, while the Nyika plateau is exceedingly well outlined on every side, not one of its outlines is more definite than the western. There the edge of it, like a great wall of rock, extending a long distance north and south, faces the traveller for a whole day's march as he approaches it from the head-waters of the Loangwa, and when he has reached it, the cliffs that have to be climbed to gain its summit are not under 1500 feet in height. On its eastern side Nyika plateau has all the appearance of a mountain range with lofty summits, some of them bare crests of rock like Nkarabwe, or rounded peaks like Mwenembwe and Nymkoa, all over 4000 feet above the lake level. Mount Waller, as has already been said, is the terminus of the Tumbuka plateau in the north. Beyond that point the Nyika plateau has its base in the plains of the lake shore. Along the upper half of the eastern face, for a distance of several miles in varying depth, there extends a girdle of primeval forest of exceeding density, impenetrable, so far as I know, except at two places, one on the summit of Nymkoa, and the other on Mwenembwe. The path up Mwenembwe twists and twines between giant tree-trunks, over and beneath huge roots and branches, interwoven with slimy creepers, and overlaid with clammy mosses and lichens, where the sun in the thinner stretches is as a ball in the sky and the stars come out, and where the ground is covered with the black *débris* of centuries and wet with the drip of a never-ceasing rain—a path, if it can be so called, which, once taken, one never desires to take again. This forest, like all the others of its kind, is being eaten

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into year after year by the grass fires which often make havoc in it for weeks on end.

The surface of the Nyika plateau is even more rugged and broken up than that of the Tumbuka plateau. It is levellest on its western side, where immense heaps of boulders and single stones of enormous size lie scattered about. There is no forest of any kind, only grass veldt, with mean scrub in the deeper hollows. The icy winds that sweep from the west and the east after sundown are apparently too severe for trees. This great plateau, at least 70 miles long by an average of perhaps 25 miles broad, and at its highest elevation over 7000 feet above sea-level, frequently shrouded in mist and intersected everywhere by clear, rapid, cold perennial streams, is the source of three important rivers. The Rukuru of Karonga rises on its western slopes, and, under the name of Kabidi, winds round its north-west base, closing it in on the north. The two others, the Lunyina and the Rumpi, have their sources side by side near what may prove to be the highest summits of the plateau between Mounts Mkunguruwe and Mparapara. Flowing to the south-east, the Lunyina joins the Rukuru of Ngoniland before it makes its way through the gorge between the mountains Njakwa and Ntoiche, and as part of that river encircles the plateau on the east; while the Rumpi, after flowing for some distance in a direction parallel to the length of the plateau, breaks through the eastern ridge in wild, deep, rocky gorges, and pours its waters over cataracts and falls into the lake close to the mouth of the Rukuru.

The Poka inhabitants of the Nyika plateau, probably the aborigines of the country, and very low in the native scale of civilisation, have little skill in cultivation. Keeping a few goats and sheep, more for barter than for use, they subsist mostly on pease. Their huts are built with a view to concealment, and are formed by scooping out the ground and covering the hole with sticks and turf. Placed, as many of them are, among the heaps of rock *débris*, it is almost impossible to detect them from any distance. On the west the gardens are made in the open, but near the east face they are to be found on the steep sides of the gorges.

Game is scarce, except when the dearth of water drives them to ascend to the perennial sources of the plateau. The elephant is then said to visit it. The wart-hog is, so far as I know, its only constant resident. The much-prized black monkey dwells in considerable troops in the skirts of the primeval forest.

The country beyond the Nyika plateau is a plain studded with single round hills of no great height. In the south-west this plain extends to the horizon, but in the north-west it terminates at the foot of massive mountain ranges and faces of other plateaus, the most notable of which is Kanyikamwaka. On the ground of elevation and actual connection this plain may be regarded, I think, as forming a part of the Tumbuka plateau with which I started.

As a whole, the district which I have been describing is very thinly peopled. The inhabited country is only a fraction of the uninhabited. From the head of the Henga valley to the Rumpi river there is not a single village. The few Poka villages scattered over the Nyika plateau

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are hardly worth counting as occupation. The Vipsya is entirely without people, and in the far west, until the traveller has descended a long distance into the Loangwa valley, he rarely encounters more than two or three villages on a day's march. The great centres of population are Bandawe among the Tonga tribe, Ekwendeni and Hora among the Ngoni and Tumbuka tribes, Kondowi among the mixed Henga and Poka, and Karonga among the mixed Henga and Konde. No exact census has yet been made.

THE DRY SUMMER ON THE UPPER NILE.

By A. D. Milne, M.B., C.M.

In the month of August, 1871, Baker Pasha wrote as follows[1]:—"All my anticipations of successful cultivation had been fruitless. The drought of this year had caused a general scarcity. The months of July and August should have the heaviest rainfall; July had just expired with a rainfall of only 1·13 inch. . . ."

This year, 1899, some 20 miles south of Gondokoro, Baker Pasha's station, twenty-eight years after the above was penned, one might almost write in identical terms of the weather and "general scarcity." *This* July has just expired with a rainfall of 2·61 inches.

On our first arrival here in the latter part of January, the first aim was to run up suitable habitations for the men; and many were the inquiries directed towards ascertaining the duration of the dry weather. Both by the soldiers themselves—most of them natives of the various tribes here and near here—and by the native dwellers in the islands, the dry weather was announced as beginning in the latter part of November and continuing on to March. In April the rain would begin "little little"—one or two days' rain and cloud, four or five days' sunshine, the latter gradually diminishing, till by June or July at latest the floods would be in full force. April arrived with weather as promised; and great was the anxiety over the possible ruin of batches of sun-baked bricks. May followed much the same as April, but with one week of heavy rain. Finally, with much rejoicing, the last brick of the season was laid; and the rain was looked for with as much eagerness as work had before been hurried and scamped for fear of it. But as June and July came and passed with a scantier and scantier rainfall, it became at last impossible to ignore the probability that this season was going to be a year of lean cattle. In May, after the heavy rainstorms, crops had been hastily put into the ground. Now, instead of dhurra-fields waving ten-foot high, the stalks are not much above the height of one's knee or waist, while the heads are all shrivelled and wizened. Some fields of *Lubia* (beans) have had to be rooted up, being scorched by the sun. The scrub bush of the jungle wears the indescribable browned and withered appearance due to excessive heat.

[1] *Ismailia*, p. 153.

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It must be remembered that I am speaking more particularly of the country immediately to the south of Gebel Regaf; and that though the conditions seem more or less general elsewhere, in certain favoured localities they are exceptional. Thus, at a village some 36 miles to the south, on a range of hills near the east bank of the Nile, are some 150 to 200 acres of crops well forward and rapidly ripening. Its inhabitants complain of no lack of rain. And away to the east, beneath the shadow of the Bellinian and Illyrian hills, crops are plentiful, I believe.

Of adverse signs the most important is the actual rainfall for this locality and the lowness of the Nile. The river has been steadily falling much below the anticipated lowest point of April, when levels were first recorded. The charts speak for themselves.

Other indications of a scarcity I noticed on a journey to Afuddo, the next station to this, 100 miles away. There I found a colony of thirty Madis, who had come across from the west bank of the Nile to the then more prosperous other side, as, owing to the lack of rain, their own crops had failed. On the way back to Fort Berkeley I passed through a village, and found all its inhabitants sitting disconsolately round their Lares and Penates. Asking what was the matter, I learned that the inhabitants of a neighbouring friendly (?) village on their way to buy corn in the Shuli country, 60 or 70 miles distant, had helped themselves in passing to the little stock of grain left. A woebegone woman sitting near by graphically filled her mouth with dirt as evidence of all she had to eat. Further on, a husband, wife, and child leading a goat were passed, the latter to be bartered for corn in the favoured Shuli country. At another village, where on the road down I had shot a couple of antelope, the Sheikh came up and greeted me with an excess of friendliness, and said he had sent some of his men out into the bush to see where the game was. This rather took me aback, as the Baris are not a sporting race, and I asked why. "Oh," he said, "all my men are at Dufileh buying food; and I," smiling and patting his stomach, "am very hungry."

Of course a certain allowance must be made for the improvidence of the native, who is not unlikely to be occasionally hard up for food at the end of the dry weather. Still, straws show how the wind blows, and judged from personal observation here and elsewhere, the scarcity is too general not to be severely felt.

The state of the Nile, and also of the Khor Asua and the Khor Atabbi and other big rivers flowing into the Nile between this and Afuddo, affords a pretty good indication that even in the mountainous regions to the east, and in the whole of the Great Lake basins, the rainfall must be small and considerably less than usual. For I take it that a permanent rise in the Nile waters here must depend chiefly on a rise in the level of one or both lakes, the big tributary rivers being responsible for the oscillations. For example, the rise recorded at Fort Berkeley on May 16th originated in a very heavy rain on the night of the 14th and several succeeding days of rain occurring in the Shuli country, 120 miles to the south-east. Through these lands run the

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Khor Asua, the Atabbi, etc. Lieut. Gage, 7th Dragoon Guards, experienced these showers on his way to Mella, a village about 45 miles up the Khor Asua, and 120 miles from here. If the Wadelai diagram for May be studied, it will be seen that there is no phenomenal rise recorded for the 13th May, which would allow of a flood traversing the 200 odd miles and more of waterway, at the rate of 3 miles an hour, reaching Fort Berkeley on the 16th. In spite of the above-mentioned heavy rains, six weeks later these rivers were all clear streams, at the most knee-deep. The Khor Asua certainly deserves all that Baker Pasha says of it, and in full flood must take some negotiating to get across. A boat has been placed at the junction of it and the Atabbi, and it will be interesting to see how it works.

The Nilometer consists of a pole firmly fixed in a mudbank, and marked in feet and inches. Five foot has been taken as an arbitrary level to work from till experience shows which is the best (*i.e.* the lowest) starting-point. Levels are noted every day at 5 P.M.

The rain-gauge consists of a zinc funnel three inches in diameter, bound together with copper rivets. It was skilfully made for me by Armourer-Sergeant Stong out of zinc packing and copper (trade) wire. I am indebted to Major Tickell, D.S.O., 14th Hussars, for the equation for working out results. The accessories consist of a pickle bottle as receiver, placed in an open space inside the fort, well away from buildings or trees. The funnel is fitted into a cork to avoid outside drippings reaching the interior. The rim of the gauge is 12 inches above ground. Readings are nominally taken every morning at 9 A.M., but with slight rain as soon as the showers are over. The water is measured in a minim measure.

Through the courtesy of Lieut. Cope, R.A., I have obtained two diagrams of the Nile level at Wadelai for the months of May and June. Unfortunately there is no datum level drawn on them.

RAINFALL.

Fort Berkeley, Equatorial Provinces.

June.

2nd,	Heavy.
4th,	Drizzle.
5th,	·0356
8th,	·003
14th,	·174
19th,	·653
25th,	1·172
26th,	·9915
Total for month,[1]	3·175 inches.

[1] Incomplete.

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JULY.

1st,	·071
11th,	·534
13th,	·178
17th,	·035
18th (thunderstorm),	·917
24th („),	·488
27th,	·154
29th,	·035
Total for month,[1]	2·614 inches.

MAY.

Slight rain.	Heavy rain.
6 days.	5 days.[2]

RHODESIA.

Report on the Administration of Rhodesia. The British South Africa Company.[3]

Impressions of South Africa. James Bryce.

THAT vast country which lies between the German and Portuguese South African possessions, and extends from Lake Tanganyika southward to the Transvaal, must at present be an object of peculiar interest to us, as it will certainly soon be one of the most important fields for British enterprise and statesmanship. Within the present year, it may be hoped and indeed expected, there will arise new facilities for the development, and new problems for the administration, of a land which is eminently fitted to become the home of a permanent and self-supporting colony. When the sources of the old unrest and insecurity shall have been done away, when political and fiscal boundaries which correspond in no respect either to racial differences or to physical divisions shall have disappeared, the normal growth of British South Africa, in population and industry, will reveal more fully what are the resources and what is to be the future of the great plateau. In the meantime it is worth our while to take notice of what has been done and of what has been discovered in those parts which are at once the most remote, the least developed, yet, in the opinion of many, not the least valuable of our South African possessions.

The Report of the British South Africa Company gives very strik-

[1] We hope to publish a diagram showing the fluctuations of the Nile, when it can be drawn for twelve months.—ED.

[2] On May 6th there was a heavy thunderstorm in the night, accompanied by an earthquake. It is interesting to note in this connection that Gebel Regaf means "the trembling hill." Natives are well aware of its peculiarities.

[3] We are indebted to the British South Africa Company for permission to use the accompanying illustrations and maps.

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ing evidence of work done; of order maintained and a complex administration founded; of minerals discovered and mines developed; of railways and telegraphs laid down; of towns established, country surveyed, and lands allotted; of agricultural experiments and of a wealth of miscellaneous scientific observations. More than four hundred pages are needed to tell of the present organisation of this ten-year-old country, yet there is abundant reason to believe that the development within the near future will be even more rapid than it has proved itself already. The completion of the railways to Bulawayo and Salisbury has altered all the conditions of life; it has greatly increased the value of the products of industry and diminished the cost of production. By opening up the country to mining and agricultural machinery, to cheaper food and to immigration, the railway has given an immense impulse

KAFFIR KRAAL.

to the colonisation of Matabililand and Mashonaland. Mines and farms, formerly held merely in speculation, are now worked and occupied; and the many and various industries which are springing up indicate a general opinion that the recent rapid growth of population will not only be maintained but will also increase.

The justice of that opinion must, in the end, depend upon the future of Rhodesia as an agricultural country. Gold will be worked out in time, and the power of modern machinery as well as the magnitude of modern operations make the process of exhaustion quicker every year. There is coal in abundance, but the country will probably require it all. A purely pastoral country supports only a small population. At last, the population must live very largely on its cultivated land. Now it has often been said that the future of Rhodesia in this respect is at least doubtful. Sceptical travellers point out that the supply of labour is uncertain, expensive, and inefficient, and that it seems almost impossible

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to teach the natives to work continuously for hire. They speak despondently of the winter drought, which makes planting impossible at that season, and necessitates irrigation for many crops; of the night frosts, which injure potatoes, bananas, tobacco, and many vegetables; and of the excessive moisture of summer, which ruins wheat as it ripens, and bursts grapes before they are fit to be gathered. They report the fatal ravages of white ants among the young fruit-trees, of locusts among the crops, and of the fly, horse-sickness, and rinderpest among the beasts. They will prove to you by figures that farming cannot be made to pay under present circumstances, and that produce can be fetched up by rail more cheaply that it can be raised on the spot; and they conclude that every branch of agriculture in Rhodesia is still experimental, and is likely to remain indefinitely at that stage.

It is well that this view should find expression. It is a caution to intending colonists that there must be a time of waiting before they may see any adequate return on their money and their work, and that in Rhodesia, even more than elsewhere, the successful farmer must be a man of ingenuity and enterprise. No rule-of-thumb methods will serve in a climate and on a soil for which the science of agriculture has yet to be made. The settler has to find what crops and what varieties of them will suit the seasons and the land; he has to select and to breed new races more perfectly adapted to these conditions; he must lay his plans for markets which are ever changing with the swift growth of railways and population. It cannot be denied that at the present moment he finds only a narrow and difficult opening for his produce. So far, indeed, the present state of agriculture is experimental.

But Rhodesia is no experiment, and the future of its agriculture is assured. That was proved before white men came there. In spite of the havoc and terror wrought by the Matabili raids of the last fifty years, the coloured population south of the Zambesi is nearly half a million, and large tracts of country, dotted with deserted and ruined villages, and crossed by innumerable paths for which there is now no traffic, show that the inhabitants must have greatly exceeded that number at the beginning of the century.

"Fifty years ago," says Mr. Selous, writing of the Mashona plateau, "this fine country must have been thickly inhabited, as almost every valley has, at one time or other, been under cultivation. The sites of villages are also very numerous, though now only marked by a few deep pits, from which the natives obtained the clay used by them for plastering their huts and making their cooking-pots, and also the presence usually of a cluster of huge acacia-trees, which grow to a far greater size on the sites of old villages than anywhere else. On the summit of every hill may be found the walls, in more or less perfect preservation, of what, I think, must have been cattle kraals. The peaceful people inhabiting this part of Africa must then have been in the zenith of their prosperity. Herds of their small but beautiful cattle lowed in every valley, and their rich and fertile country doubtless afforded them an abundance of vegetable food."[1] And their descendants, whose methods of cultivation are

[1] *Travel and Adventure in Africa*, p. 80.

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very primitive, and who certainly do no more work than they need, not only raise enough food for themselves, but sell many thousand bags of grain every year to the colonists.

The natives cultivate a considerable variety of crops. They grow pumpkins in swampy soils, raising them between August and the rains,

TELEGRAPH CONSTRUCTION.

in their "winter gardens"; and mealies or Indian corn form an important crop at the same season. A white millet called *Munga* has the great advantage of being untouched by the swarms of locusts which first reached this country with the European colonists. Kaffir corn or *Mabele* is the chief grain of the Matabili, who use it to make both their porridge and their beer. *Poko*, the favourite Mashona grain, is raised

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in large quantities in that country as well as in India, but does not occur elsewhere in Africa; it grows in all situations and in any soil, and produces a small seed from which a highly nutritious meal is derived; and rice is widely grown in certain swampy districts. The pea or monkey nut is extensively raised by the natives, who use it to make a very heady beer and extract its oil for cooking purposes. They cultivate it over large areas of light sandy soil in every part of the country, and it forms one of their largest crops. Where an uncivilised and indolent people can do so much, both with stock and with cereals, the land is fitted for agriculture in no ordinary degree.

The capacity of Rhodesia in this respect has already been proved by the colonists in the few years that have passed since our entrance into the country. They have had some trouble in finding out when the different varieties should be sown, but crops of wheat and barley have been raised in sufficient quantity to show that the land is highly suited for both of these grains. Two crops of Cape oats are reaped annually, in October and April, and are made up unthreshed into bundles for forage. Barley is grown in damp and low-lying soil, and is given to horses as green food, and maize has turned out the most remunerative crop of any, yielding about a ton to the acre.

The cultivation of tobacco has been successful. The soil and the climate are both favourable to this plant, though it requires irrigation in winter, and is then liable to injury by frost unless protected. Most of the crop goes to the natives in exchange for grain. Vines grow well, but it is evident that special varieties must be produced by selection and crossing before the best fruit can be obtained; the grapes must be made to ripen in the dry season, and not, as is the case at present, in the middle of the summer, so that the skin cracks because of the damp. For this purpose both early and late varieties have been tried, as well as those having specially thick skins, and late pruning is recommended as retarding maturity.

Besides indigenous fruits, some of which are of excellent flavour and will be further improved by cultivation, almost all European fruit-trees have been tried, in the majority of cases with encouraging results. They bear early; seedlings and cuttings of peach, fig, and pomegranate yielding good fruit in the second or third year; but all the trees are still too young to allow of any very certain forecast. A serious proportion of them are killed by the white ants, from which it seems impossible to protect them.

The indiarubber creeper, *Landolphia*, a native of Rhodesia, though not generally distributed throughout the country, will probably become one of the most important products, and its cultivation is being undertaken on a large scale. Its fruit is pleasant to eat and the creeper is very rich in rubber. This is extracted by the natives, who make it up in balls and sell it to traders. The demand for rubber is indefinitely large, and if the natural forests of the creeper were economically administered a considerable trade might be done. Cotton also occurs almost all over the country, which is eminently suited for its cultivation, but this valuable industry has not yet been taken up in the

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way it deserves. Before our manufactured cotton was available, the natives made use of this fibre for the manufacture of cloth. Aloes, flax, hibiscus, and other fibrous plants are well distributed and grow in great

CAPE TO CAIRO TELEGRAPH LINE.

profusion, and from these the Mashonas have learned to make good twine, ropes, and nets. They use the bark of certain trees for the same

VIEW IN THE MATOPPO HILLS.

purpose, destroying immense numbers of saplings by peeling them in a very wasteful manner. Another valuable indigenous shrub is the castor-oil plant, which is found in every kind of soil. These few

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instances sufficiently indicate the variety of the resources and possibilities of this country.

The soil is very various, and every degree of it, from the lightest sandy soil to the black peaty loam which is characteristic of the lower lands, may be found even upon the same farm. The ant heaps, which occur in great numbers, are broken up to enrich the earth, their formic acid being a valuable fertiliser. The same purpose is served by the calcareous tufa which is found in many places; it is burned and spread over the ground. The annual grass fires, which kill thousands of young trees, are said to have an impoverishing effect upon the soil by depriving it of the organic débris which would otherwise be deposited every year by the heavy growth, and by allowing the moisture in the earth to evaporate. In the Barotse valley, where the Zambesi yearly invades a tract 100 miles long and from 10 to 30 miles wide, very heavy crops are raised on the rich loam. Major R. T. Coryndon, the Company's Resident, gives a graphic picture of its fertility :—

"The river has now (Jan. 28th) been brimming its banks for some days, and the water is creeping slowly along the hollows of the plain. In another three weeks the canoes will begin to travel over the footpaths, and in six or eight weeks a view from my present camp at Mongu would show a waste of yellow water, with now and then a little kraal perched upon an anthill showing above the water, dozens of small canoes crawling about where lands, huts, paths, and cattle kraals used to be. The flood is usually at its height during the first week in April, and from that time it slowly subsides, leaving grass six to ten feet long, and the whole valley reeking with rotten and rotting vegetation. It does not need expert knowledge to prove the fact that at this time of the year, and for one or two months afterwards, the whole valley is merely a hot-bed for malarial poison.

"Towards the end of the dry weather the plain still presents a green appearance, and feeds thousands of very fine cattle; during the flood every head is sent up to the mosito or sand-belts, and in fact but few natives remain in the flooded valley. The king moves off to the forest as soon as the water is high enough to float his big canoes just outside Lialui. Kraals are dotted everywhere, and every little pool holds numbers of duck, geese, egrets, and a large variety of wild-fowl. The heaviest population, however, is immediately under the sand-belts. There are hundreds of small kraals in an almost endless chain following the course of the belts, each kraal is buried in its lands, and now, at this time of the year one can ride mile after mile along the edge of the sand-hills, without seeing more than the tops of the huts buried and smothered in a perfect wealth of mealie, Kaffir corn, sugar-cane, and medanja (manioc) lands. Famine is unknown in the valley, for locusts do not do much harm to the lands where there is such an abundance of green stuff, and the soil—like that part of the Nile annually inundated—is very rich, for it is, to an extent, renewed every year. On those parts of the valley raised slightly above the neighbouring ground—though nevertheless covered by the floods—the white sand shows out with tufts of tough grass, but generally even this sand is so impregnated with the alluvial loam carried down every year and sifted out over the whole valley, that it will grow a very fair crop."

Pasturage is very good throughout a large proportion of Rhodesia, and the principal wealth of the inhabitants has always consisted of

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cattle. But the grazing will be much improved when it is more heavily stocked, and the introduction of new blood into the native breeds of cattle, goats, and sheep will give better results than can be attained at present. Angora goats and merino sheep have been imported recently

SALISBURY FROM THE KOPJE.

with apparent success, though the merinos will only thrive in the higher and more open country. But it will doubtless be some time before the breeds most adapted to the colony can be perfected. The native grasses,

OLD FORT TULI.

cut in March and April, make good hay, which is readily taken by all kinds of stock, and realises from £4 to £7 per ton.

Owing to the epidemic of rinderpest, which carried off 95 per cent. of the cattle, their number is at present very low; but confidence is

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returning, and a great number are now being brought into the country. Both the natural exhaustion of the disease, and the compulsory inoculation and other vigorous measures which have been taken upon the occasion of every outbreak, have reduced the plague so much that though isolated cases continue to occur from time to time, yet the administration and its scientific advisers have got complete control of it. The country will now be rapidly stocked with cattle.

Agriculture has suffered greatly from the insufficient supply of beasts for transport and ploughing. Horse sickness still kills large numbers of mules and horses every year, but certain of Dr. Edington's experiments give reason to believe that preventive inoculation will be found successful in this disease also.

Dr. Edington has rendered a further service to the colony by the systematic application of a poisonous fungus to the destruction of the devastating swarms of locusts. The remains of insects which have died from the disease are dried, powdered, and mixed with water; young living specimens are then washed with this solution, and are set free to contaminate the swarm. The locusts, when followed up, are found to perish in large numbers, and the fungus is to be seen growing out of their bodies. This toxin is also cultivated separately, and is supplied to natives and colonists in tubes.

There is no doubt that many difficulties have still to be met, and that many experiments must still be made, before the agricultural resources of Rhodesia can be adequately developed. Yet, on the other hand, there is no doubt that cereals, cotton, tobacco, and rubber can be successfully cultivated over large areas of the country, and that, with the improvement of communications and the education of labour, these crops will become very important elements in the prosperity of the country. They will support a considerable population even when the mines shall have been worked out.

With a view to the determination of land properties, the survey of Rhodesia was undertaken in 1897, and has already made considerable progress. During the first season, a chain of triangles was selected and beaconed from Bulawayo towards Salisbury, under the direction of Dr. Gill, F.R.S., H.M. Astronomer at the Cape of Good Hope. In May 1898 the astronomical latitude, longitude, and azimuth were determined at Bulawayo with the aid of telegraphic time signals from the Royal Observatory at the Cape, and a measured base line of 12½ miles was laid down on the watershed near the Insiza river. At the end of the year a chain of triangulation nearly two hundred miles long had been established. Mr. Rhodes having promised to supply the funds necessary to extend the triangles of the geodetic survey north to Lake Tanganyika, it has been decided to run a strong chain of triangulation from Tuli to Gwelo, along the 30th meridian to the western boundary of Portuguese East Africa, and thence to the southern end of the lake. From this basal survey it will be possible to carry triangulation to any part of Rhodesia for the purpose of property surveys.

No complete exploration of the forests of Rhodesia has yet been made, but it is estimated that there are about 2000 square miles of forest in

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Matabililand, while Mashonaland is not so well timbered. It is likely that a careful administration by a forestry department would lead to a considerable development of both countries in this respect; at present, the annual grass fires kill innumerable young trees; the natives are

COFFEE PLANTING—NURSERY, BLANTYRE.

answerable for the destruction of many thousands; and the felling of large timber is attended with much unnecessary destruction of the smaller trees. The Gwaai forest, which extends along the river of that

DRYING COFFEE—BLANTYRE.

name, fifty miles from Bulawayo, is profitably worked by a company which supplies the native teak or *ikusi* for building material. This forest also consists of several varieties of acacia, syringa, and *mopani*.

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There are always fine trees along the banks of the more important rivers. The Shangani river passes through a forest of baobab, which is the largest tree of the country. Large areas of Mashonaland are covered with teak. The *mahobohobo*, which has a fruit somewhat resembling the medlar, is thickly spread over the Selukwe and Belingwe districts; it is especially valuable for mining purposes because its wood resists the white ant.

The time has not yet come for an accurate estimate of the mineral resources of Rhodesia, but experience is increasing the confidence in their value. Coal is distributed over large areas, as the accompanying map indicates; it is being actively developed in the more accessible regions, while the extension of railways to the distant fields is being undertaken. Copper and iron occur to an extent which has not yet been determined. But gold is the prize which Rhodesia chiefly offers; it is the expectation of a large yield of payable gold that has brought capital and population to Salisbury and Bulawayo. Upon the value of its gold reefs the rate of the country's growth will depend. Until batteries had been long enough in operation to prove the richness of the deposits, and to give experience of the cost of production, the favourable opinion which commonly prevailed was largely due to those innumerable ancient workings which afford evidence of the practice of gold-mining from very remote times until the present century. Prospecting, the registration of claims, and the incorporation of mining companies have been carried on to a great extent for several years, but it was not until 1898 that the actual production of gold was begun on a sufficient scale to show how the reefs were likely to turn out. Since the opening of the railway milling plants have been sent up for several mines, and the result, so far, has been favourable. The total output for the year ending October 1898 was 12,757 ounces, and for the following year 67,169 ounces, and a return from the Bulawayo Chamber of Mines shows that the value of the gold produced in the ten months preceding June 1899 was £192,679. The average working cost per ton of ore crushed is about twenty-five per cent. less in Matabililand than at Johannesburg.

In consequence of the difficulty of obtaining native labour for the mines, a section of the mining community has urged the Administration to undertake the organisation of a more regular supply of workers. This request has very wisely been refused; but the Chamber of Mines has organised a bureau which endeavours with considerable success to engage labourers throughout southern Rhodesia, and even from districts north of the Zambesi. It is expected that a moderate increase in the hut-tax will somewhat relieve the difficulty, as at present the natives can earn all they need by a month's labour in the year. There seems to be no attempt to evade the tax, which brings in about £42,000 from Mashonaland and £22,000 from the Matabili tribes. This, with the other revenues of the Native Department, is just sufficient to defray the ordinary expenses of administration, but leaves no balance available towards the heavy cost of the police.

The natives have been provided with large Government reserves, consisting of land suitable for agriculture, and sufficiently extensive, if

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required, to support the whole indigenous population. Residence within these reserves is optional, but the natives prefer to be located on these Government lands rather than on the properties of private owners. Crime is rare, and the population is rapidly adapting itself to the changed conditions. There is little reason to fear another rising such as that of 1896. The tribal organisation of the Matabili, which had reached a high development during their warlike career of the last two generations, has become gradually disintegrated, and the peaceful Mashonas are incapable of combination. Under a just administration, securing their property and their freedom, the natives will increasingly take their place in the economic growth of the country. The immediate control of the natives lies in the hands of native commissioners, chiefs, and district headmen, appointed on account of their character and of their position. Although the climate of Rhodesia is, throughout a large extent, suitable for European labour, it is probable that the race feeling will leave all outdoor work in the hands of the natives, and they will certainly, at least for a time, multiply faster than the whites. The education of the coloured people to labour, and the preservation of their confidence, are therefore necessary to any firm progress; and the regulations of the Administration show a full recognition of the importance of a just and enlightened treatment of the natives.

Mr. Bryce, in his deeply interesting *Impressions of South Africa*, devotes a considerable section of the book to Rhodesia. The work is characterised by an admirably judicious spirit; as historian and as traveller Mr. Bryce is able to estimate both the promise and the difficulties of to-day in what we may believe to be something of their true proportions. The qualities of sanity, and of experience, and of a very quick perception, make this book the best available account of Rhodesia as an undeveloped colony. It remains, of course, an "impression," but the time has not come for any more intimate study—so much more lies in the future than has yet become actual. Mr. Bryce looks upon this country, at least in its higher portions, as destined to become the home of a settled British population, in respect that the climate is healthy and even bracing, so that children may grow up there as strong as they would at home, and the race renew itself from generation to generation. He finds that the whole country, except the low grounds towards the Zambesi and in the south-east, which are (for so long as wild game remain) infested by the tsetse fly, is suitable for pasturing cattle or sheep; and that, after every allowance has been made for the poorer tracts of dry or sandy soil, there remains an immense area of land which is fitted to raise cereals and certain sub-tropical crops such as cotton. The difficulties which at present attend native labour seem to be to some extent transitory. The author points out that the managers of the Kimberley and Johannesburg mines have succeeded in securing a sufficient force of workers, and anticipates that the inhabitants of Rhodesia will shortly acquire the habit of working steadily for wages. The problem will be solved as soon as the natives have learned to need more than a skin cloak or cotton cloth, and therefore to desire money together with

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the things that cost money. Until there is competition for work, employers must be prepared to tempt these people who have never known what labour is, by payment that appears to be excessive. With regard to the future of gold-mining, the author, while in the meantime suspending judgment, admits that results have been actually obtained in some places which promise extremely well if the rest of the reefs should prove equal to the portions sampled, and that men of "a conservative temper" think that there is payable gold, and probably plenty of it, in the country.

Some of Mr. Bryce's most interesting observations refer to the quality and character of the men who are laying the foundations of the people of Rhodesia. A comparison of the new towns, such as Gwelo, with similar centres of the mining industry in western America, is eminently favourable to the former: gambling and excessive drinking are at least not evident; there is no shooting; crimes of violence are rare, and the tracks are safe. The British have carried with them their respect for authority and law, and are, on the whole, whether in the towns and about the mining camps, or scattered on isolated farms, men who promise well for the colony. "It is not the least of the pleasures of such a journey," says Mr. Bryce, describing the stages from Bulawayo to Salisbury, "that one finds so many cheery, hearty, sanguine young fellows scattered about this country, some of them keeping or helping to keep stores, some of them showing what the soil may be made to do with skill and perseverance, and how homes may be reared upon it. One is always hospitably received; one often finds in the hard-working pioneer or the youth behind the store counter a cultivated and thoughtful mind; one has, perhaps, a glimpse of an attractive personality developing itself under simple yet severe conditions, fitted to bring out the real force of the man. After half an hour's talk you part as if you were parting with an old friend, yet knowing that the same roof is not likely ever to cover both of you again. There are, of course, rough and ill-omened explorers and settlers in South Africa, as in other new countries, but, having wandered a good deal in different countries on the outer edge of civilisation, I was struck by the large proportion of well-mannered and well-educated men whom one came across in this tropical wilderness."[1]

These and other features of Rhodesia as it is to-day appear, from the political point of view, to give the conditions for a strong and energetic colony. Where the climate is stimulating and Europeans may make their permanent home, where agricultural and pastoral lands of immense extent and large mineral resources offer their due reward to work and enterprise, where the country is being administered and developed along the lines of a bold and enlightened policy, and where men of the best type are rapidly taking their place as colonists—there we may find the promise of political security, and look forward to the genuine and stable expansion of British South Africa. Mr. Bryce, in a passage with which we may well conclude our notice of his admirable book, emphasises the

[1] *Impressions of South Africa*, p. 228.

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supreme importance to our more southern colonies, of Mr. Rhodes' policy in the establishment of the country which bears his name :—

"To the English race in South Africa the acquisition of these regions, or at least of the parts south of the Zambesi, has been an immense political and economic advantage. It has established their predominance, and provided a security against any serious attempt to dislodge them. A philosophic observer, without predilections for any one state or people, would, it is conceived, hold that the English race is more likely to serve what are termed the interests of civilisation in this part of Africa than is any other race. The Portuguese have neither energy nor capital. The Germans, with energy and with capital, have not the requisite practice in independent colonisation, nor perhaps the taste for it. The South African Dutch Boers, who have within the last seventeen years been more than once on the point of occupying the country, are, with all their good qualities, a backward people, who, had they prevailed, would have done little more than squat here and there over the country with their cattle, and carry on an incessant, desultory war with the natives. Whether it is really desirable that the waste lands of the world should be quickly brought under settled order, and have their resources developed with all possible speed, is a question on which much might be said. But assuming, as most men perhaps too hastily do assume, that this sudden development is desirable, the English are the people most likely to carry it out effectively, and the strong and strenuous man who, with little encouragement from the Government of his country, founded the British South Africa Company, and acquired these territories for his countrymen, took one of the most fateful steps that statesman or conqueror has ever taken in the African continent."[1]

GEOGRAPHY AT THE EXHIBITION OF SCOTTISH EDUCATIONAL WORK FOR PARIS EXPOSITION, 1900.

"WEAK" must be the verdict applied to Scottish Geographical Education, although possibly it is as good as any to be found within the British Isles. It does not strike one that this is the fault of the children and youth of the country, but that it is due to the ignorance, so far as geography is concerned, of the teachers; and this again is accounted for by their not being trained efficiently in the subject, geography being considered as unimportant in the eyes and heads of those in charge of the Education Department. Among the children's work exhibited is seen too much of meaningless county marking and town dotting, without any basis of the physical features of the country, and of mountain chains like caterpillars crawling across the paper. Mapping of distant lands, and practically no maps of the village school and schoolroom they are taught in; laborious insertion of lines of latitude and longitude, which are beyond the comprehension of the child—and in many cases the teacher also. Mechanical copying from other maps, often very bad ones, and not from the map which may be laid out for them by Nature—from, for instance, the top of Arthur's Seat. Too much hard bench, dry-as-dust, laborious, uninteresting work; too little outdoor, refreshing work, which

[1] *Impressions of South Africa*, p. 279.

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is as full of interest as anything can be. Geography made a toil instead of a recreation.

There are hopes, however. There's a gleam of light from Gordon College, Aberdeen, Outlook Tower and St. George's Training College, Edinburgh, and the Royal Asylum for the Blind, Glasgow.

Undoubtedly the best exhibition is from the Gordon College, Aberdeen. The pupils here have excellently surveyed their own college, and have made good maps of the district; and thus have the best foundation for understanding maps of other parts of the world which they have not, and probably will not have, a chance of seeing. Their cross-sections of country drawn from contour maps are excellent, the one illustrating the other's respective significance. Some of the maps drawn from geometrical figure skeletons are good; and many of the diagrams, such as those illustrating British commerce, are useful, especially if they have been compiled from original data, as they appear to have been. The College also exhibits a surveying instrument, which we understand was actually made in the workshops of the College, and used for the survey work done. Outlook Tower exhibits an excellent model of Edinburgh and district, ever so much more comprehensive—especially for the constructor—than any number of flat maps. The only other model maps to be seen are three of the British Isles, exhibited by the Royal Glasgow Asylum for the Blind. Are not these maps also useful for those who have eyes and see not? Why are there not more model maps used in the teaching and learning of geography? There are very beautiful casts and models on exhibition from the Dundee School of Art; some by pupils of only seventeen years of age. Why should not geography as well as art make use of this excellent talent? Throughout the exhibition there is a wonderful display of talent for modelling and designing, but geography is not making use of it. St. George's Training College exhibits a series of well-coloured physical and industrial wall-maps of Scotland—these should be in greater profusion in such an exhibition, replacing the old-fashioned dry maps. Some of the College's illustrations of flora and coast-scenes are also good, and far more useful than many maps. Outlook Tower also exhibits similar illustrations, as well as an interesting full-coloured map of the Lothians, showing the distribution of crops and other vegetation.

Of the elementary schools perhaps the maps of Standard VI. of Old Monkland School Board are on the whole best. The colour is good, and the shading for elevation, instead of "caterpillars," more intelligible. Standards V. and VII. in the same school, however, are not of so high a quality. There is a good map, showing even contour, by one Radford Souter, aged eleven years, of Ferryhill School, Aberdeen. We hope that the excellent work and energy of this small boy is also devoted to mapping his own school and village more particularly than of more distant parts of the country.

We must congratulate the organisers of this exhibition, as well as the exhibitors, especially Principal Grant Oglivie, the organising secretary, and trust that where we now see only the dawn of geographical teaching in Scotland, at a not far-distant date we may be enjoying the

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full strength of its light in the education of the country, recognising that geography is one of the most important, and not one of the least important, subjects of education for a country that has taken upon itself the responsibility of governing a larger surface of the globe than any other civilised power. W. S. B.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meeting of Council.

At a meeting of Council held on 17th January, the following gentlemen were elected Members of the Society :—

Sir William J. Bell, LL.D.
George Smith, M.A.
Surgeon J. Stoddart, R.N.
L. H. Strain, B.A., LL.B.
W. A. Taylor, M.A.

Meetings in January.

On the 8th January, Mr. J. B. Tyrrell, formerly of the Canadian Geological Survey, now mining and civil engineer of Dawson City, read a paper in Edinburgh on the Upper or Canadian portion of the Yukon Basin. Sir John Murray, President of the Society, occupied the Chair. Mr. Tyrrell read the same paper before the Dundee Branch on the 9th, when Mr. I. Julius Weinberg presided ; and before the Aberdeen Branch on the 10th, Mr. John Clark, M.A., being the chairman.

On the 15th, Mr. W. Barbrooke Grubb read before the Glasgow Branch a paper entitled "The Chaco—the Country and its People." Mr. Gourlay presided. Mr. Grubb addressed the Society in Edinburgh on the same subject on the 18th, when a discussion ensued, in which the Rev. Lyall Wilson, Mr. Hope Gibson, and others took part.

Meetings in February.

Mr. W. Rickmer Rickmers will give an account of his recent travels in Bokhara to the Society in Edinburgh on the 8th February, in Aberdeen on the 12th, in Dundee on the 13th, and in Glasgow on the 14th. He will show a series of lantern views of special excellence. Dr. Koettlitz, who accompanied Mr. Weld Blundell and Lord Lovat on the journey through Somaliland and Southern Abyssinia to the Shangalla country and the Blue Nile, and through the Sudan to Egypt, will address the Society in Edinburgh on 22nd February.

GEOGRAPHICAL NOTES.

AFRICA.

Railways in Africa.—Egypt has 2085 miles of railway. Tunis has already 652 miles, to which the lines from Moknine to Sfax, and from Saguan to Kairuan, will be added. Since 1862, railways with an aggregate length of 2051 miles have been open in Algeria, and new lines are projected. In Senegambia France has a railway 164 miles long, from Dakkar to Saint Louis, and in the Sudan Kayes

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and Debubeba are connected by a line 99 miles long, which will be continued to Bamako and Tulimandio, 260 miles farther. Sierra Leone has 31 miles, from Freetown to Songotown, and this line will be carried farther into the interior. On the Gold Coast is the railway from Segundi to Tarqua, 37 miles, and Lagos is connected with Abeokuta, 37 miles distant. Besides the great railway from Matadi to Leopoldville the Congo State has a line, 18½ miles, from Boma to Lukula. The Portuguese line from Loando to Ambaca (lately opened to Lukula, 273 miles) will be continued 93 miles farther to Malangue, and the line from São Felipe to Katumbela is 18½ miles long. The Swakop and Windhoek railway in German South-West Africa is said to be 161 miles. Cape Colony has 2786 miles, and extensions are under construction. Natal has 494, the Orange Free State 596, and the Transvaal 1202. There are 250 miles of railway in Portuguese East Africa, 169 in Mauritius, while St. Pierre, St. Denis, and St. Benoit in Réunion are connected by a railway 79 miles long. German East Africa has only 56 miles, from Tanga to Karagwe, while the British Uganda railway is already open for nearly 400 miles. Thirty miles of the French line to Harrar (155 miles) have been constructed, and the line is to be carried to Addis-Abeba. Lastly, in Eritrea a line 17 miles long connects Massana with Saati. In all, Africa has 11,877 miles of railway, of which 3863 are in British Colonies, 2085 in French, 492 in Portuguese, and 217 in German.—*Geogr. Zeitschrift*, Jahrg. xv. Heft 2.

Mayotte is the easternmost island of the Comoros, to which group also belong Great Comoro, Anjouan, and Mohilla. They occupy the middle of the northern extremity of the Mozambique channel, Mayotte itself lying between 12° 44′ and 13° 5′ S. lat., and between 42° 2′ and 45° 19′ E. long. In contrast to other groups in the neighbourhood—the Seychelles, for instance—the Comoros were inhabited on the arrival of the Portuguese, and the Arab element predominates in the population to the present day. People were also introduced from the coast of Africa, mostly as slaves ; the Sakalavas of Madagascar established a settlement on the island, and Hovas followed their chiefs thither, many of whom obtained command of the island. The French, who had occupied Nossi-Bé, made a treaty of annexation with the chief men in 1841, but the government was left in the hands of the native sultans until 1892. The languages most in use are Kisuaheli, Arabic, and Malagasy. The Europeans in the island are few, and are solely owners or managers of plantations and the higher officials. The population of Mayotte numbers about 12,000, and that of the whole group about 80,000, of whom half live on the largest island, Great Comoro, 411 square miles in area. The area of Anjouan is fully 151 sq. miles, of Mayotte 146⅔, and of Mohilla 93⅓.

The whole group is of volcanic origin, but in this century volcanic activity has manifested itself only on Great Comoro, where eruptions have been rather frequent and sometimes destructive. Great Comoro is hilly throughout, and rises steeply from the sea to the culminating summit of Mount Kartalo, 7900 feet above sea-level. Anjouan is also lofty, 5300 feet, but is by far the most beautiful and fertile of the islands. Mohilla and Mayotte are much lower, though reaching to 2100 feet ; the striking mountain, Uchungui, on Mayotte, rises immediately from the plain to a height of 2106 feet, and is wonderfully like a sugar-loaf. The soil is everywhere very productive, and suits almost all tropical crops. The climate is oceanic and comparatively temperate for the latitude. The temperature attains a maximum in January of 85·3°, seldom rising to 89½°, and falls in June to 69·3° ; the annual mean is 77°. The daily range is small, and this is very beneficial to the crops. The water varies

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in temperature from 75° to 80°, and therefore a sea-bath is not refreshing. The seasons are, of course, marked by the north-east monsoon, which sets in in November and brings rain with it, and the lighter, cooler southerly winds which begin to blow in the middle of March. Cyclones are almost unknown, the islands being sheltered by Madagascar, but in 1898 two cyclones caused great devastation and loss of life. Dzaudzi, the capital, consists of some thirty houses, most of one storey only, which belong almost exclusively to officials.

A coral reef surrounds Mayotte to a distance of twelve knots from the shore, leaving, however, good passages free for vessels. Around the shore are mangrove swamps, breeding the fevers so fatal to Europeans. The forests are not of high growth; bamboos, splendid magnolias, baobab, mango, and other beautiful trees thickly entwined with lianas are frequently seen, as also wild orange and coffee trees, the *Pandanus*, and the aloe; coco palms are comparatively rare. Except domestic animals, the largest creature is the little brown lemur. The flying dog and the bat are not uncommon. Birds also are plentiful, especially pigeons.

The trade, owing to the small number of European inhabitants and the few needs of the natives, is insignificant. A few Indians, most of them from Zanzibar, are the retail dealers, while the Europeans obtain their goods direct from France. The chief import is rice from India, flour from Hungary, lamps from Australia; and a little petroleum and cotton cloth for clothing come from Marseilles. The export trade is more important, and from the whole group will probably reach the value of £200,000 in the next five years, if nothing unforeseen occurs. Sugar-cane appears to find especially favourable conditions for its growth; coffee is on its trial; vanilla has suffered from the cyclones, but promises to yield good crops; and cocoa has been entirely given up. There is no grazing, animals for food and draught being almost all imported from Madagascar.—From an article by Captain Guido Couarde in the *Mitth. der K.K. Geogr. Gesells. in Wien*, Bd. xlii. Nos. 9 and 10.

AMERICA.

The Valley of the Urubamba.—D. Luis M. Robledo read a paper on this important highway of Peru before the Geographical Society of Lima, in January 1899 (*Boletin*, Año viii., Trim. 4to). Where the cordilleras of the coast form a junction with the eastern cordillera, called the *nudo* of Cuzco, the Urubamba or Vilcanota descends from the flanks of the snow-clad mountain of the same name situated in lat. 14° 31′ 50″ S. and long. 75° 33′ 19″ W. Then it skirts the cordillera north-westwards to the base of the lofty mountains Ollantaitambo and Panticalla, where the axis of the Andes turns directly to the west. The river cuts across the cordillera in a northerly direction by a narrow defile, and, passing onwards, emerges after a torrential course among the northern spurs of the cordillera into the vast plains where it unites with the Tambo or Apurimac to form the Ucayali, in lat. 10° 43′ 30″ N. and long. 78° 25′ 4″ W. In this long course it traverses a distance of 870 miles, and passes from the cold climate of the highlands to the hot, wooded plains, at a height of 650 feet above sea-level.

This great valley appears to have been in Tertiary times the site of an inter-Andine lake, of which the lakes of Titicaca, Poopo or Aullagas, and Coipasa are remnants, and now affords a natural highway gradually descending from the lofty tablelands of the Andes to the trans-Andine plains with their network of navigable channels.

The valley of the Upper Urubamba traverses the whole of the cold and temperate region where the population is densest and agriculture and industries

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most highly developed. Bordering on the Department of Puno, the provinces of Canas and Canchis extend on either side the Vilcanota, as the Urubamba is called here. In the secondary valleys, more or less extensive, cereals are cultivated, such as wheat, barley and maize, potatoes and quinoa (*Chenopodium quinoa*), among the stunted vegetation; while on the elevated tablelands coarse grass affords pasturage for numerous flocks of sheep, llamas, alpacas, and vicuñas. Beyond rise peaks capped with perpetual snow, where there is no vegetation, and only the vizcacha is found hiding among the clefts of the rocks and the condor soars above the icy solitudes. Besides fleeces of sheep, alpacas, and vicuñas, the source region of the Vilcanota produces silver, lead, and mercury. Its commerce converges to the railway, which terminates at the town of Sicuani, and the road to Cuzco, and at Sicuani there is a large trade in alcoholic liquors, cereals, flour, and wool. There is also a rough route, practicable only for llamas, to the neighbouring province of Carabaya, which takes cereals from Canchis and Paucartamba, in exchange for gold, cheese, salt meat, and coarse woollen materials.

The left bank of the river belongs to the province of Canas, which extends to the basin of the Apurimac. Its territory is an elevated tableland 13,000 feet above sea-level, and its physical aspect and productions are similar to those of the source region of the Vilcanota, but its topography is more favourable to traffic and commerce. Between Cailloma and the Vilcanota are important mines that were at one time worked, and the extraction of petroleum has been attempted, though unsuccessfully, in the neighbourhood of Santa Rosa. But wool (of sheep, alpacas, and vicuñas) is the chief export, the annual value amounting to £57,300. Tallow and hides are also important articles in the trade with Arequipa and foreign countries. Were attention paid to the improvement of the breeds of cattle and sheep, the value of the grazing industry might be increased tenfold.

The population of these provinces is 76,000, of whom two-thirds are Indians. The condition of the latter, generally tenants of small farms, is extremely hard. In return for his land the Indian is subject to burdensome obligations to his landlord—a survival of the old colonial system—and, without the stimulant afforded by the prospect of gain, produces little. The free Indian, on the other hand, is often the owner of large flocks, and adds to his wealth by the transport of goods, being almost always the owner of the llamas he drives. The half-breed, of robust physique, energetic and much more ambitious, is not so common as in other provinces, where he has entirely superseded the pure native. He needs only a little more education to become the most vigorous element in the national prosperity; to this class belong the artisans, the lower officials, and the majority of the electors.

To the west of Canas, and in close commercial contact with the valley of the Urubamba, is the vast province of Chumbivilcas. Though it has rich mines of gold and silver in Colquemarca and Santo Tomas, this province with its extensive undulating tablelands, abundantly watered and covered with pasturage, is essentially pastoral, and its inhabitants, robust and independent half-breeds, maintain an important trade in wool, cattle, horses, and gold with Arequipa. The population is 20,000.

The next provinces northwards are Acomayo and Paruro, sloping to the Urubamba and Apurimac on either side. This region is essentially agricultural, and may be called the granary of the south of the Department. It produces wheat and flour of excellent quality, and good results have been obtained by planting Chilian smooth-eared wheat, particularly on the river flats, where the native species does not thrive so well. The population of this zone is 35,000.

On the right bank of the Urubamba lie the large provinces of Quispicanchi

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and Paucartamba, rich in herds, mines, and forest produce. Both contain vast territories on the eastern slope of the main cordillera, which at this point presents a most marked orographical arrangement. Here rises the colossal Ausangate, visible in the most distant parts of the Department. Higher than the famous Chimborazo, and perhaps as lofty as Ilimani, it is the nucleus from which two great ramifications start, and from this latitude the axis of the cordillera makes a decided westerly bend. One of the offshoots maintains the old northerly direction, and in the angle between the two chains begins the great valley of the Rio Paucartambo, Ocongate or Mapacho, which ultimately enters the Urubamba as the Yavero. This chain contains snow-covered peaks in the neighbourhood of Ausangate, but as it advances sinks in altitude, only occasionally rising into the region of eternal snow. It is this range which, farther north, accompanies the Urubamba from the Pongo de Mainique, and forms the watershed between the Ucayali and the Madre de Dios, Purus and Yavari. The other branch, known as the Colqui chain, runs north-eastwards, dividing the basin of the Marcapata from the valley of Cosñipata. To the east of the chain bordering the Mapacho rise the rivers Qqueros, Pilcopata, Tono and Piñipiñi, which form the Madre de Dios, and to the south the Marcapata descends from the flanks of Ausangate. It is still a question whether this river is a tributary of the Madre de Dios or enters the Inambari (see vol. xiv. p. 484), which must be at most 60 miles from the famous auriferous hill of Camanti, the lowest point attained in the valley of the Marcapata. Being the nearest valley of the forest region to a railway station, it has given rise to a scheme of colonisation, with a river port on the Inambari or Madre de Dios, 190 miles from Sicuani.

The auriferous region of Paucartamba extends on both sides of the river, and at the beginning of the century was very productive; but now the extraction of gold is left to the Indians, who are content to obtain just enough to cover their necessities. A considerable amount of wool is used up in the factory of Lucre, and maize and wheat are exported to the neighbouring provinces, to Carabaya and Cuzco. Timber gives rise also to a considerable traffic. All the trade of this zone, with its population of 36,000 souls, converges to the valley of the Urubamba, and for the most part is absorbed in it.

From Urcos commences that section of the Upper Urubamba which has given to the valley its renown as a beautiful country with a splendid climate. It contains many picturesque towns, including Yucay—the favourite country resort of the Incas—Urubamba and Ollantaitambo, with its famous ruins. On the left, connected with the Urubamba valley by the valley of the Huatany, Cuzco stands in an amphitheatre on a tableland, 11,470 feet above sea-level. It is the administrative and commercial capital of the whole Department, and, above all, of the zone now under consideration, together with the province of Anta, which runs north and west above the basin of the Apurimac. The zone is agricultural, producing abundance of maize as well as other cereals and fruits of temperate climates. The cattle are only sufficient to supply the local demand for meat and draught animals. The province of Anta, however, exports cattle. The climate of the Yucay valley is favourable to the silk-worm, and bees and vines have been successfully tried, though with insufficient capital and knowledge of their cultivation. There are also mines of silver, copper, lead and iron, and Maras possesses a deposit of rock salt which supplies the whole consumption. The population of this zone is 72,000, including the 20,000 inhabitants of Cuzco.

Thus far the river has excavated its bed through the primitive rocks of the Andes and the sedimentary formations that cover their flanks. From Ollantaitambo and Panticalla the cordillera runs due west, but a branch containing the

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snow-covered mountains of Lares, the lofty peaks of Condorsencca and Mesa Pelada, maintains the old direction, forming the valleys of the Yanatili and Ocobamba. As far as Chilca the Urubamba skirts the base of the cordillera, but there it cuts through the range in a north-westerly direction, having excavated a cañon 60 miles long and 330 yards broad on an average.

At the passage of the main cordillera the middle course of the river begins. For 250 miles the river, carrying down some 2000 cubic feet of water per second, makes its way past the slaty spurs on the north and east of the cordillera, changes its direction suddenly, pours over enormous cataracts, and beyond the Pongo de Mainique, another gorge similar to the cañon of the cordillera, enters the boundless plains. The Torontoy road skirts the bank of the river, in some places cut through the solid rock 1000 to 1300 feet above the foaming torrent. At Huadquiña begins the province of La Convencion and the succession of farms scattered over the spacious meadow-land which the valley encloses beyond the cordillera, the cultivated fields extending up the flank of the sierra, or half-hidden in the side ravines and peeping out from amidst the dense tropical foliage. The valley of Santa Ana extends from the slopes of the cordillera to the mouth of the Yanatili, where the inhabited part comes to an end. This province, with a resident population of 12,000, has a splendid future before it, not only through its agriculture but also owing to its mineral wealth and its suitability for cattle-grazing. Coca, cocoa, sugar and coffee are the chief crops; and rice, tobacco and cotton are grown only for home consumption, as labour and transport to tend and convey them are wanting. The cordillera of Vilcabamba, which shuts in the province on the west, is the mining and grazing district. It has rich veins of silver, now no longer worked, and also copper, lead and nickel.

Beyond the Vilcabamba sierra the main cordillera diverges to the north-west, gradually retiring from the Urubamba and Apurimac. At the peak of Orosayhua, a mass of iron ore, the Urubamba turns sharply to the west from the confluence of the Yanatili, and flows west for 56 miles, and then again turns north-eastwards to the Pongo de Mainique. Many tributaries join it here. The country is rich in Peruvian bark, and on the river flats grow vanilla, wild cocoa, india-rubber, gutta-percha, and various gums.

The river Yavero, which enters the Urubamba above the great cataracts of Maguntone, Chibucuni, and Sintulini, has been the subject of much controversy, but in 1898 its identity with the Paucartambo was at length proved. The valley of this river is very interesting in many respects, and the exploitation of its forest produce, and its healthy elevated pastures, will be of great importance when the road to Puerto Samanez is finished. Most valuable are the trees of the Sapotaceæ family, which yield gutta-percha as good as that obtained from the *Isomandra percha* in Borneo. Their existence here was unknown until 1897.

At the entrance of the Pongo de Mainique the immense volume of water plunges into a narrow gorge, 50 feet wide at most, and forms the fearful whirlpool of Chibucuni. Then the river glides on placidly for about a mile, receiving many torrents from the cliffs on either side, and at last emerges from the gorge by the grand portal of Tonquini.

The Lower Urubamba flows through an immense forest-covered plain. In the distance are seen the outlines of the hills which separate its basin on the east from that of the Mano and Purus, and on the west from that of the Apurimac. These chains of hills accompany the river northwards, and give rise to many navigable tributaries. From the eastern tributaries, especially the Misagua and Camisea, the Mano may easily be reached (see vol. xii. p. 100). The port of Samanez or Sihuaniro, at the head of navigation on the Urubamba, is sure to

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become a great commercial centre with so much natural wealth in the neighbourhood—alum, gutta-percha, vanilla, gums, cocoa—an excellent climate, and lands suited for agriculture ; and the Government should, as soon as the road from Cuzco is open, establish an administrative centre here. The greater part of the rubber collectors will unload their cargo at this town instead of making for the Yurua and other rivers.

The Woods of Porto Rico.—Mr. R. T. Hill, of the U.S. Geological Survey, who has already published so much on this island, contributes "Notes on the Forest Conditions of Porto Rico" to *Bulletin* 28, U.S. Department of Agriculture. At the time of its discovery Porto Rico was completely covered with forests of many species of trees; but now, except a few insignificant patches in the central and north-western parts, it is largely deforested from a commercial point of view, though it still presents to the casual observer the aspect of an open wooded landscape, individual trees being dotted about over the country. Two principal zones of vegetation may be distinguished—the one occupying the mountainous regions and the north coast, the other the foothill country of the south coast. The former is a region of great and constant humidity, high altitudes, and stiff clay soils ; the other of dry, calcareous soils, seasonal aridness, and low altitude. The transition between them is very abrupt.

The general growth of the mountain region consists of deciduous trees of many species, intermingled with shrub and grass, and above 1000 feet with tree ferns. Much of the mountain land is now occupied by cultivated fields, and scattered trees have been left to shade the coffee, or fresh ones planted. On the summit of El Yunque there is still a remnant of old forest. Though only 3200 feet high, this mountain is always bathed in moisture, and the rainfall amounts to 120 inches a year. The forest consists of an almost impenetrable jungle of trees underbrush, and lianas. In general, it resembles the forest of other West Indian islands, but is peculiar in being almost destitute of epiphytic plants. The second class of flora on the foothills of the southern slope consists largely of low shrubby, thorny, leguminous and acacia-like trees.

Mr. Hill collected specimens of sixteen kinds of wood used by the people, nine of which were found to be very hard, close-grained, and heavy. Some beautiful furniture is made out of the native woods. It is impossible to ascertain the value of the timber exported, but as that of the total non-agricultural products is under £2000, the export lumber trade must be inconsiderable.

GENERAL.

The Periodic Variations of Glaciers.—The International Commission on Glaciers, presided over by Professor E. Richter of Graz, has issued its fourth report. Out of seventy glaciers measured in the Swiss Alps, twelve are advancing, while fifty-five are certainly receding. In the eastern Alps also the retrograde movement is maintained, though not with the same rapidity as in the period from 1870 to 1890. While the tongues of ice then melted away entirely, they now advance during the winter, forming small moraines. In Sweden M. Westman has studied the glaciers of Sulitelma. A comparison of the measurements of the Stuorajekna glacier with those taken by M. Svenonius shows that the glacier is in the same state as it was six years ago. Its movement is twice as rapid in the height of summer as in the remainder of the year. Dr. Westman finds that the density of an isolated grain is greater than that of the ice in the glacier. The glaciers of the Caucasus are, according to the report of M. J. Mushketof, receding, with the exception of the Adyl, and its advance is probably due to the formation of its bed. Several reports are also contributed from the Arctic regions, America, and the Himalayas.

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NEW BOOKS.

In Western India: Recollections of my Early Missionary Life. By the Rev. J. MURRAY MITCHELL, M.A., LL.D. Edinburgh: David Douglas, 1899. Pp. 405. *Price* 5*s.*

This volume is dedicated by the venerable writer to his wife, herself the author of a popular work, *In Southern India*, etc. The two little books form pleasant pictures of Scottish Missionary experience in Bombay, and on tour in the Madras Province. Dr. Murray Mitchell, himself the cultured product of Aberdeen, is well fitted to be an authority on "the religious thought and feeling of Western India" when he left it, so long ago as 1863. Had this volume been written at that time it must have been a valuable contemporary record of the years 1838-1863, with which it deals. As it is, we have a pleasant narrative of recollections in which, though the perspective is sometimes lost, the personality of the writer is pleasantly evident. After a five years' ministry at Broughty Ferry, Dr. Murray Mitchell returned for a few years to India and did good work at Calcutta, but of this period he does not treat. His work was essentially Marathi among the Marathas, of whom he writes with fulness of knowledge. There is a good map of Western India, but no index.

British Africa. With four Maps. London: Kegan Paul, Trench, Trübner and Co., Ltd., 1899. Pp. 400 + Appendix, pp. xiii. *Price* 6*s.*

Most of the papers in this volume were given at the Sunday afternoon course of lectures at the South Place Institute, Finsbury, London, E.C., between the years 1895-1898.

It is as well that they have been collected in a volume, especially just now, as our attention is so specially directed to Africa.

As Dr. Scott Keltie indicates in his preface, all of the writers are more or less authorities on the special subjects with which they deal.

The Cape, Rhodesia, Bechuanaland, the Transvaal, Old and New, Natal, Zululand, British Central Africa, Uganda, our West African Colonies, are the headings of some of the chapters, and indicate the scope of the volume.

It cannot be expected that all the papers are of equal merit, but, with one or two exceptions, the level of interest is rather above the average of such productions, and the intelligent reader may be sure that he will gather much information from the book. We must refer readers to the volume itself, as space cannot be given for a detailed review of twenty-two essays.

It should be noted, however, that some of the writers show considerable bias in presenting their views. This is under the circumstances unavoidable, and the judicious reader will know well how to discount personal predilections.

Great Britain has a great task in Africa, and anything which tends to awaken interest in that continent is useful, and whereas in the volume before us such weighty matters as the balance of power, the treatment of subject races, the conflicts of opinion between professed experts are set forth, a calm judgment is needed, and that we ask for this book.

Bábar. By STANLEY LANE POOLE, M.A., Professor of Arabic at Trinity College, Dublin. ("Rulers of India.") Oxford: The Clarendon Press, 1899. Pp. 206. *Price* 2*s.* 6*d.*

The claim of Zahír-ad-dín Muhammad or Bábar to be one of the rulers of India is based on the two years after the victory of Kanwaha in 1527 A.D., in which he

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pulverised the power of the Rajputs. By this battle he became master of an empire which "stretched from Kunduz and Badakhshán by the Oxus to the borders of Bengal and from the Himalayas to Gwálior." And as far as India is concerned he is famous as the victorious general who founded the Moghal dynasty, the last scion of which ended his days a few years ago in Rangoon, and he was grandfather of the still more illustrious Akbar. Called to the throne of a turbulent province on the north of the Jaxartes at the age of eleven, he had already learned master-lessons of courage, promptitude, and resource, which were needed from the moment of his father's death. It is impossible for us even to epitomise the story of his life; one of startling vicissitudes which called forth qualities of kingship and generalship, such as are rarely found in the East, or for that part of the matter rarely found in history. Happily for us, he is for the most part his own historian, and his *Memoirs* unconsciously disclose a remarkable character. He was, as Mr. Lane-Poole justly observes, "a cultivated man of the world, well read in Eastern literature, a close and curious observer, quick in perception, a discerning judge of persons, and a devoted lover of nature," as well as "a man of fine literary taste and fastidious critical perception." As revealed in his *Memoirs*, "the man's own character is so fresh and buoyant, so free from convention and cant, so rich in hope, courage, resolve, and at the same time so warm and friendly, so very human, that it conquers one's admiring sympathy. The utter frankness of self-revelation, the unconscious portraiture of all his virtues and follies, his obvious truthfulness and fine sense of honour, give the *Memoirs* an authority which is equal to their charm." Mr. Lane-Poole has done his work well in as much as he has allowed this "prince of autobiographers" to tell his own story in the little volume before us. The *Memoirs*, however, have many hiatus, but their blanks have been supplied from the best authorities available. We can recommend this story of Bábar as second to none of the "Rulers of India" series.

Tirol. Von MAX HAUSHOFER. *Schweiz.* Von J. C. HEER. *Land und Leute*, herausgegeben von A. SCOBEL, Nos. IV. and V. Bielefeld und Leipzig: Verlag von Velhagen und Klasing, 1899. Pp. 198 and 192. *Price M.* 4 *each.*

These books belong to the same series as *Norwegen* and *Cuba*, which were noticed in the November number. The authors are natives of the countries described, and each knows his native land thoroughly. Both Switzerland and the Tyrol, though small in area, abound in beautiful scenery, and in the former the resorts of tourists are very numerous. Consequently in a few instances the descriptions are not much more than a list of place-names with a short remark on each. As a whole, however, the work is well done, and the general chapters on the people and their history, climate, and glacial phenomena, are all that is required in a popular book. The illustrations, as in the former volumes, are well chosen and excellently reproduced from the photographs. Each might, however, have been placed nearer to the text in which it is described.

Nederlandsch Indië onder het Regentschap von Koningin Emma, 1890-1898. Batavia: G. Kolff and Co., 1898. Pp. xvi + 351.

Several Dutch authors, well known in their respective professions, have here combined to give an account of the progress made in various directions in the Dutch East Indies during the years when the Queen Dowager of the Netherlands acted as Regent. The book contains little that is strictly geographical. In the chapter on Land- en Volkenkunde, by W. P. Groeneveldt, we find a list of travellers, but only a mere statement of the regions visited and the kinds of observations made, for the book is chiefly intended as a record. Other scientific

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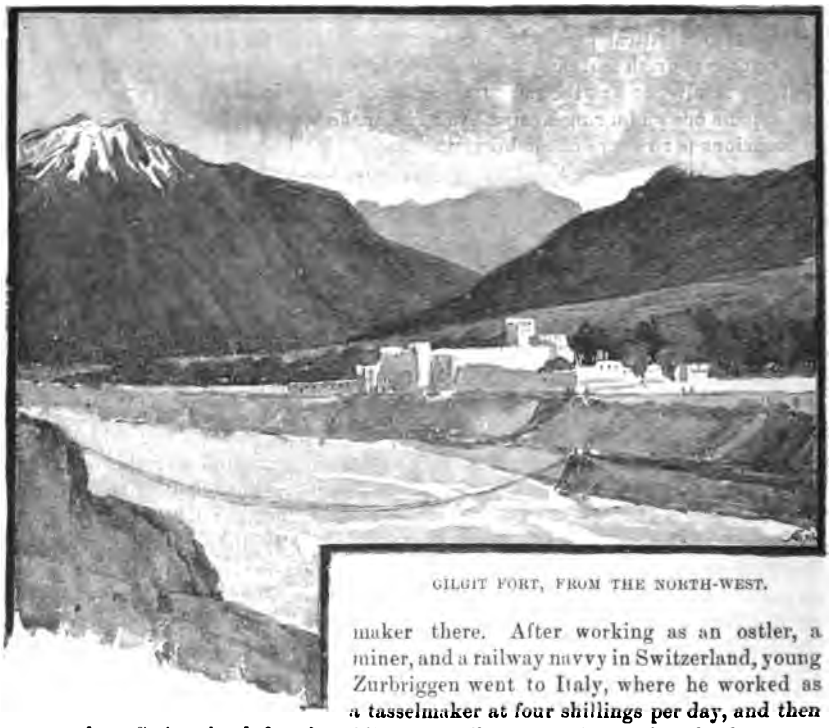
chapters are Taal- en Oudenheidkunde, by Dr. J. L. A. Brandes; De Studie der Levende Natur, by Dr. M. Treub; Mijnwezen en Aardkunde, by Dr. R. D. M. Verbeek; and Meteorologie en Aardmagnetisme, by Dr. J. P. van der Stok. In some of these the information is more detailed, the railways, for instance, their length, cost, revenue, etc., being described at some length. Reference is also made to articles and books that have been published on various subjects.

From the Alps to the Andes. Being the Autobiography of a Mountain Guide. By MATTIAS ZURBRIGGEN. London: T. Fisher Unwin, 1899. Pp. 269. *Price* 10*s.* 6*d. net.*

Every Alpine climber will welcome this, the Autobiography of the greatest of all guides, who, with the modesty of true greatness, recounts his wonderful career as simply as if he had done nothing remarkable. Mattias Zurbriggen was born at Saas Fee in Canton Valais, Switzerland, in 1856, his father being a shoe-



GILGIT FORT, FROM THE NORTH-WEST.

maker there. After working as an ostler, a miner, and a railway navvy in Switzerland, young Zurbriggen went to Italy, where he worked as a tasselmaker at four shillings per day, and then returned to Switzerland for the obligatory military service. Then he became a postilion and thus met a Swiss gentleman who took him to Tunis and Algeria, where he afterwards worked as a smith, but had to leave Algiers on account of excruciating headaches.

Returning to his home at Macugnaga, near Monte Rosa, he acted in 1886 as one of the guides of an Austrian who made the ascent of that mountain. This was Zurbriggen's first great climb, and he was then thirty years old. The Matterhorn was his next ascent, and then an Englishman engaged him and they made several ascents together. Other Englishmen employed him, and in 1889 he made with Mr. E. H. Fison an ascent of the Matterhorn, during which Mr. Fison lay down

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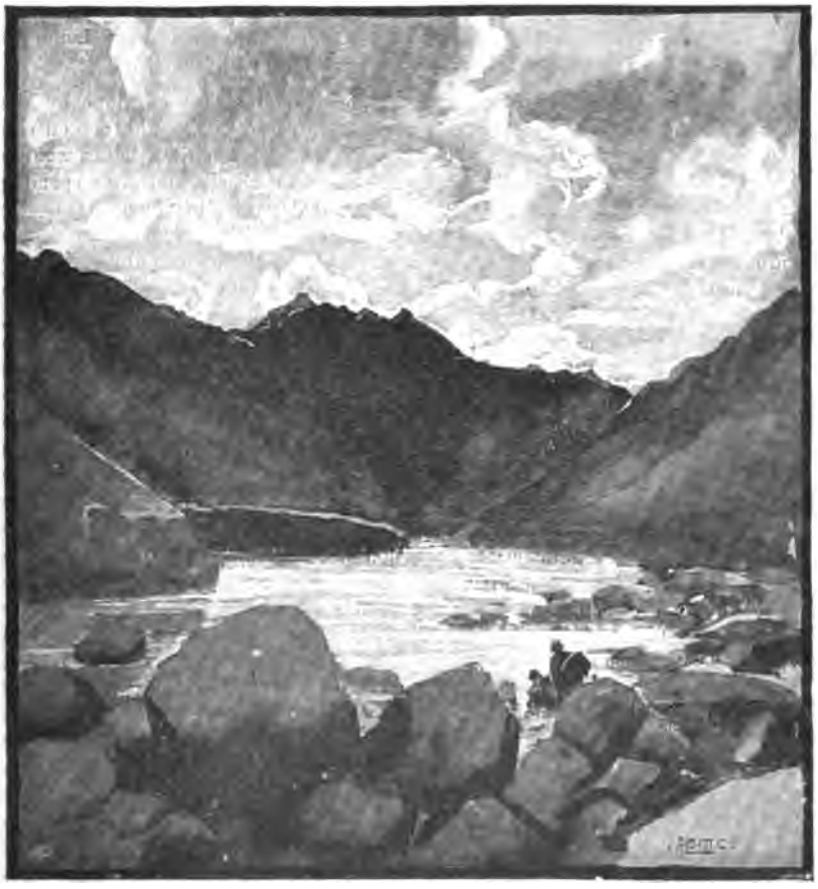
exhausted in the snow and refused to move. Zurbriggen made him move on, and saved his life by the expedient of belabouring him soundly! At this stage of his Autobiography Zurbriggen gives certain valuable advice regarding guides and climbing which all Alpine men should carefully peruse.

In 1891 Zurbriggen was engaged by Mr. Fisher Unwin and two other Englishmen to ascend the Matterhorn, and on descending he met Mr. FitzGerald, with whom he afterwards was to do so much climbing. He also met Sir Martin Conway,



LOOKING DOWN THE ASKOLE VALLEY FROM THE FOOT OF THE BIAFO GLACIER.

who engaged him as a guide in the Himalayas, whither they went in 1892, and climbed various peaks of great altitude, winding up with the Pioneer Peak (23,000 feet). After an expedition to Western Tibet and visiting Leh, the party returned to Europe.

Next year Zurbriggen ascended Mont Blanc with Mr. Edward Whymper, and in 1894-95 he accompanied Mr. FitzGerald to the New Zealand Alps, and they ascended Mount Tasman (11,475 feet), and Zurbriggen scaled alone Mount Cook (13,000 feet), the highest peak in New Zealand. The rest of the book describes

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their visit to the Andes when, in January 1897, Zurbriggen made the first ascent ever known of Aconcagua (23,082 feet), the highest peak in America, this being the crowning triumph of a career unequalled in the annals of mountaineering.

In a supplementary chapter Zurbriggen tells how, in August 1899, he returned to the Himalayas and escorted Dr. and Mrs. Workman to the top of a peak 19,450 feet high, which they named "Mount Bullock Workman," and then ascended Mount Kosergunge (21,150 feet), Mrs. Workman having thus "climbed 4000 feet higher than any other member of her sex."

Two Women in Klondike. By MARY E. HITCHCOCK. New York and London: G. P. Putnam's Sons, 1899. Pp. 485. *Price* 12*s.* 6*d.*

If ladies in Scotland could arrange to "do" Klondike as it was done by Mrs. Hitchcock and Miss Van Buren, we suspect that Dawson City would soon outrival St. Andrews or Nairn as summer quarters. These two American ladies went to the El Dorado by the all-water route, *i.e. viâ* St. Michael's, and after spending only two months, *i.e.* August and September, at Dawson, in a huge tent, they returned *viâ* the Skagway Pass. In Dawson they became the idols of the traders and miners. Apparently their tent was practically open to the public, and they most heartily enjoyed and appreciated the attentions they received on all hands. It is only fair to add that they earned the goodwill of the rough community by readily adapting themselves to its ways, and by gentle womanly kindnesses to the sick. They, like the rest, had come "to make their million," and in the two months ere they left they seem to have put themselves in a fair way to be successful. They made the acquaintance of a Klondike king, whose personality is discreetly veiled in capital letters, and through his instrumentality they staked out claims in various places, the possible value of which is enormous. Not content with one string to their bow, they had brought with them an animatoscope, the principal features of which were scenes in the American-Spanish War and a prize fight—a judicious combination which irresistibly appealed to the inhabitants of Dawson, and when they left that city their prospects of a large and steady income from the animatoscope might make Sir Henry Irving green with envy. They, of course, soon discovered that many of the people with whom they were associating were military officers, university graduates, etc., who showed a marvellous and most convenient dexterity in chopping wood, washing dishes, cooking muffins and the like. We were under the impression that life in Dawson City was a hard one, and that food was often scarce, and generally simple. These ladies, however, apparently never needed to do anything for themselves, and as to food, here is the menu of a dinner which they gave to six people:—Anchovy on soda-biscuit, Mock-turtle soup, Roast moose and potato-balls, Escalloped tomatoes, Asparagus salad with French dressing, Peach ice-cream, Cakes and French coffee—all washed down by sparkling Mozelle! The book certainly presents life in Dawson City in a light very different from that in which it has hitherto been presented to the public.

In India. By G. W. STEEVENS, author of *With Kitchener to Khartum, Egypt in* 1898, *The Land of the Dollar, The Conquering Turk*, etc. Crown 8vo. Pp. vi + 365. With a Map. London and Edinburgh: William Blackwood and Sons, 1899. *Price* 6*s.*

We have here collected into a book a number of studies on Indian subjects. They were for the most part contributed to a newspaper, during a tour in India last winter and spring, by the well-known literary impressionist whose name appears

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on the title-page. It is needless to say that, from his point of view, they are exceedingly well executed, and the casual reader will glance over them with pleasure and amusement, if not with delight. Not many readers, however,—certainly none who have any knowledge at first-hand of British India—are likely to take too seriously the sketches of a literary artist who puts into his work such a touch, for example, as this, *à propos* of the plague :—

"It is difficult to be certain of statistics in a country like India, where a constitutionally nervous Government withholds all the information it can; but even the few figures quoted disclose a situation which in Great Britain would be thought appalling. In India nobody cares"—a manifest libel in more clauses than one.

Or this, *à propos* of the uniform of the European officers of native cavalry :—"It was almost startling to see white officers in such a kit—a brick-burned face with yellow eyebrows and moustache looking out under a peaked cap of scarlet velvet, with a vast blue turban wound round it; a huge chest under a khaki tunic, whose tails proclaim it first cousin of the oriental shirt; a broad scarlet kummerbund under the regulation belt; orange breeches and long black boots. It was one more revelation of the wonderful Englishman who can make himself into half a savage to make savages into half-civilised men"—an absurd exaggeration both in fact and reflection.

Or this, concerning the inhabitants of Calcutta :—"But by his legs you shall know the Bengali. The leg of a free man is straight or a little bandy, so that he can stand on it solidly : his calf is taper and his thigh flat. The Bengali's leg is either skin-and-bone, the same size all the way down, with knocking-knobs for knees, or else it is very fat and globular, also turning in at the knees, with round thighs like a woman's. The Bengali's leg is the leg of a slave"—which is not even picturesque nonsense, much less clever sense.

Or this, concerning the native public services :—"Thus native assistants assist. The white man [in this case a forest officer] is out in the cold dead hours before dawn, when the beasts are gone to sleep and the birds are not yet awake, when the very trees doze and the forest is a cavern of black silence, stirred only by the plump of heavy dewdrops on to the decaying leaves below. The natives are in bed; and when the white man comes in back-broken at sunset he has two hours of asking why they did not do their work, and of doing it for them. By this means, despite the neglect of many generations, the forests are slowly filling up with straight, young trees, and the bookshops with works on the gratifying efficiency of our native public services. That is exactly India"—vivid in some respects, but grossly misleading in others. For one thing, who that have lived strenuous Indian lives, military or civil, but can name many native subordinates who stinted neither labour nor pains—risked health and life—and were assistants that could not, in their places, be bettered? How many such Anglo-Indians have known as much as one European, who used to get up at an unearthly and (in that climate) unhealthy hour to do his own business, and laboured at the end of the day at doing his native assistants'?

Quotations need not be multiplied.

The best things in the book are the descriptions of places visited and scenes witnessed by the author. Much of these is bright, graphic, original. Take as examples the chapters entitled "The Camp of Exercise," "Darjiling," "The City of Shah Jehan" (by the way, why Shah Jehan? Agra is Akbarabad, the city of Akbar), "The Khybar," "The Complete Globe-Trotter," "Hyderabad Dekhan." The observations made on Indian affairs are sometimes striking and true. But, on the other hand, in many of the views, reflections, and stories, the practised ear will detect echoes of the cynical and flippant, if amusing,

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commonplaces of Anglo-Indian clubs and messrooms. There, one and another of the smartest talkers are almost sure to have disordered livers, or grievances against the country or the Government, or a malicious delight in making most things Indian assume before the ingenuous globe-trotter (especially if he be a crack correspondent) "the features of a huge jest." Such echoes were, in fact, to be expected here. During a rambling tour of a few months over the Indian continent a survey of little except the surface (and by no means all of that) is possible. In the interpretation of things both upon and below the surface of which the visitor may, by eye or ear, become cognisant, he will naturally be guided by such light as is thrown upon them by the English-speaking people amongst whom, for a few hours at a time, he happens to be. For sound information, therefore, as to the social and moral situation in India, or a trustworthy judgment upon its people and administration, one will scarcely turn to this book. This fact discounted, however, it will be found full of entertaining and lively writing.

Our Island Empire. A Handbook of Cuba, Porto Rico, Hawaii, and the Philippine Islands. By CHARLES MORRIS. Philadelphia: J. B. Lippincott and Co. Pp. 488.

Judged by this little work, our American cousins have lost no time in taking stock of their new territories beyond sea. Mr. Morris, however, strains the term "Empire" by including Cuba in it, for, by the treaty of Paris, the U.S.A. do not possess Cuba, but merely "occupy" it as Britain does Egypt, which is not included in the "British Empire." Otherwise, the book is an admirable one, each island being described under eight heads, viz.:—1, History; 2, Physical Conditions; 3, Natural Productions; 4, Civil and Political Relations; 5, Centres of Population; 6, Manners and Customs; 7, Agricultural Productions; and 8, Manufactures and Commerce. There are clear maps of the islands by Messrs. Rand, M'Nally and Co., Chicago. Regarding the political significance of the United States acquiring territory beyond sea, Mr. Morris makes the following pregnant remarks:—"This country has lifted the anchor which hitherto held it fast to the American continent, and has drifted far over the seas into the arena of Colonial international relations, from which it has hitherto striven to keep clear. What the result will be, no man can predict. We have primitive populations to civilise, indolent populations to stimulate, hostile populations to pacify, ignorant populations to educate, oppressed populations to lift into manhood, and teach the principles of liberty and the art of self-government. And we are thrown suddenly into the turbid maelstrom of the Eastern Question, with its impending problem of the possible partition of the ancient empire of China among a host of land-hungry applicants."

A Class-Book of Modern Geography. With Examination Questions, Notes, and Index. By WILLIAM HUGHES, F.R.G.S., late Professor of Geography in King's College, London. London: George Philip and Son, 1898. Pp. xvi + 472. *Price* 3*s.* 6*d.*

These pages contain a large collection of geographical facts, all of which it would be impossible to verify. We notice that Usunada is given as the terminus of the Transcaspian railway, which has been removed to Krasnovodsk, and we find no mention of one of the most remarkable features of the Asiatic continent, the Turfan depression, sinking many feet below sea-level. It is incorrect to speak of the Nicaragua ship canal as "now approaching completion." The system of introducing small sketch maps has been adopted in this book.

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THE DEVELOPMENT OF HABITABLE LANDS: AN ESSAY IN ANTHROPOGEOGRAPHY.

By HUGH ROBERT MILL, D.Sc., LL.D., F.R.S.E.

FROM the geographical point of view the development of a land usually means something more than making the largest possible sum of money out of it in the shortest practicable time. Such "development" as that idea conveys may possibly be the only kind applicable to very remote regions, which could never be made available for permanent human habitation; but for habitable lands, or lands which may become habitable, it is absurd. Looking on the world as not only the home of man, but as subservient in all its phenomena to the welfare of the human race, we may consider the development of any region to mean such a treatment of its natural resources as will enable the land to continue to support its inhabitants as their number increases. In the case of a new land, that is, a region the resources of which are yet unutilised, and which is practically without inhabitants, the problem of development is presented in its easiest form. It becomes very difficult, however, when the density of population approaches the limit at which the means of subsistence threaten to be insufficient: then it becomes the serious problem of the development of old lands. The only case to be considered here is the development of the new lands of the temperate zone; but the possibility of a land growing old and exhausted must always be borne in view. Immediate advantage would be purchased too dear if it involved exhaustion instead of development—killing, instead of feeding, the goose which should lay the golden egg of the future. The question of developing lands becomes complicated in detail, because it involves large economic considerations and difficult distinctions between investment and speculation; but the broad principles are clear enough, and their application may be left in the hands of those whom they practically concern. It

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would appear that fortune-hunting is inimical to development in its true sense. A fortune can usually be made through production or speculation by only a few individuals, and almost always by the exhaustion of natural resources or by the lowering of wages; a prosperous livelihood, on the other hand, can usually be secured to a multitude without permanent impoverishment of the land.

The development of a habitable region, which implies the expenditure of labour or capital with a definite end in view, will be considered here from the point of view of civilised mankind in general. Thus considered, it is essentially the process of securing a permanent adjustment of people to the land on which they live—a geographical problem which lies, it is true, at the root of politics, but which is not treated here from its political side.

The natural resources of a region may be broadly divided into two classes, those which occur in the crust of the Earth and are therefore limited in quantity, and those which utilise the sources of energy external to the Earth and are therefore capable of being increased in quantity by appropriate means. The former class includes all minerals, precious metals, metallic ores, coal, precious stones, etc. These form a sort of reserve fund the amount of which in existence cannot be increased, and even if very large should not be treated as if it were inexhaustible. The latter class includes all vegetable and animal products. They can be improved by cultivation and breeding, as well as increased, in favourable conditions, to any desired extent. It includes also such natural sources of energy as the heat and light of the sun, the power of wind and of running water. These resources may be looked upon as income, which cannot be drawn upon in advance, but is always punctually paid, and may in some cases be laid by for the future. As a transitional form between the two classes one may consider such resources as can only be produced slowly but may be readily destroyed. Of these, forests are the best example; if once destroyed, they cannot be renewed without the lapse of several generations, and sometimes not at all.

Generally speaking, the requirements of a civilised people which ought to be met by their own land are (1) material for food and clothing, which come from the reproducible resources of the vegetable world and depend upon soil and climate; (2) material for houses, implements, machinery, and means of transport: these come on a small scale from the forests, but on a large scale only from the substance of the Earth's crust, and their distribution has nothing to do with the present distribution of climate; (3) the power of doing work. This third requirement is of very far-reaching importance, for it has to do with every form of agriculture, of mining, of manufacture, and of transport. The energy supplied by human or by animal power is too little to be of much service in doing work on a large scale. It is true that primitive tribes may do a great deal in the way of hunting and fishing, in cultivating ground and building dwellings, in making canoes and travelling thousands of miles in them on inland waters, all by the strength of their own arm, or the aid of their domestic animals. But neither distant voyages on the ocean nor rapid travel on land is possible without making use of the

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larger powers of nature. These may be drawn from the accumulated treasure of mineral fuel, which once exhausted will not likely be replenished, or from the wind, running and falling water and solar radiation, to which for practical purposes may be added the tides and the internal heat of the Earth. The second class of sources of energy may be drawn on freely without risk of exhaustion; and when, in a few centuries, coal and petroleum can no longer be obtained, the work of the world must be carried on by the means which were in use before mineral fuel was discovered, but applied by new methods unknown in ancient times. It is conceivable that economical processes of storing and transmitting light, heat, and power electrically may be invented which will supersede the use of coal even while it is still available in large quantities. The coal-problem, which thirty years ago seemed to be the key to the whole history of civilisation, has now ceased to be a source of supreme anxiety. As yet, indeed, the coal-fields continue to rule the industrial world, and in all industrial countries they are the seats of the densest population. But within the last few years we have seen great industrial centres being formed not only round the giant falls of Niagara, but on the innumerable torrents of Switzerland, Norway, Sweden, Finland, and in the heart of the Scottish Highlands. If the movement of population from the coal-fields may not be said to have yet begun, at least the industrial monopoly held by coal-fields for a century is being threatened by a rival destined to success. It is clear that at different stages of culture or of practical inventiveness different natural resources attain the chief importance and different regions come to the front as the most favoured by nature for the life of the time. The new tendency as regards the sources of power is an eminently healthy one, being towards the utilisation of the inexhaustible supplies due directly or indirectly to daily solar radiation.

If a self-sufficing region is to continue self-supporting an effort should be made to regulate the use of mineral resources so as to postpone their exhaustion, while not reducing the output to such a degree as to hamper the development of the agricultural resources or of industry. The soil, on the other hand, should be treated so as to maintain or increase its fertility, by the ultimate return of all the mineral salts extracted by the crops, and the restoration also of the combined nitrogen removed in the same way. The necessity for this is not at once apparent in virgin soils, but many years of continuous cropping do not elapse without a significant reduction of fertility calling for remedial measures. An ideal state of things results in those places where grain is grown not for export but for feeding live-stock, which, living on the land, return to it most of the valuable salts as manure; and when the animals are exported as preserved meat or meat extract, the bones and waste products of the slaughter-houses are worked up into fertilisers which restore the balance. In the scientific sense it is only the adoption of an advanced agriculture which can be said to develop the land at all, but in the long-run if all the forests are sacrificed to make room for fields, too much agriculture may help to ruin a country. Forest and field should exist together, and in the proper places efforts as strenuous must be made to protect extensive woodlands from fire or reckless cutting, or to replant waste land with

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trees, as are usually bestowed in wooded countries on making clearings for farms.

Finds of gold or diamonds have often been of service in drawing population to countries not otherwise attractive, which when developed by agriculture have yielded far more from the fields than from the mines; California and Victoria are cases in point. There is no development possible in working out a small supply of precious metal by the introduction of an army of men, fed for a year or two on imported provisions, and withdrawn as soon as a better-paying field is discovered, perhaps at the other end of the world. For the true development of a country, mines of iron and coal, leading to the establishment of industrial works on a small scale at first and gradually growing with the local demand, are far more valuable than a rush of thousands of diggers to a new gold-field. Naturally an exception to the conservative treatment of mines may be made in the case of mineral resources occurring in countries incapable of being permanently inhabited, such as the polar regions. There can be no objection to robbing a land fit for no better fate.

Gold exercises an influence on the imagination which can only be characterised as magical, for it is not reasonable. The physical toil of getting alluvial gold is perhaps heavier than any other, the prices of the necessities of life are higher on gold-fields than anywhere else, and more money seems to be wasted on drink or lost in gambling in the intervals of mining than in any other conditions. The fact that gold is the common standard of value probably accounts for the illusion that gold-fields are better worth travelling to and working on than coal-fields or brick-fields. If the reader takes the trouble to divide the annual output of the gold-fields of the world as officially declared, with the official number of miners engaged upon these fields, he will find that the output per man often does not exceed £1 per week, and very rarely exceeds £2. Wages on these gold-fields usually run from £3 to £5 a week at the cheapest, and there is the cost of machinery and interest on capital looming large behind. There is certainly something wrong, perhaps with the statistics, but perhaps in the idea that gold-getting is usually profitable. That some gold mines pay high dividends, then, only makes it more mysterious how the others continue to exist. It has been suggested that taken over all gold-mining never pays, that more than £1 has to be expended in order to extract gold enough to make a sovereign, and that this fact explains why gold maintains its value nearly unaltered in spite of the enormous increase in its production. I do not profess to understand, and do not wish to press this argument, but mention it parenthetically as a thing to think about.

In speaking of the development of a self-sufficing country we introduce a condition which can be satisfied only by a country which covers half a continent like the United States, or a whole one like Australia. But when the high state of efficiency of means of transport, especially by sea, is taken into account, even the British empire, scattered over all the world, may be considered as one country which might certainly be self-sufficing. The possible extension of the principle of federation or economic union even raises the thought—visionary enough just now—

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that the only self-sufficing "country" to be ultimately dealt with is the whole land-surface of the planet. Most of the countries of the world are only endowed by Nature with a portion of the commodities which civilised life demands as necessaries or refinement requires as luxuries; hence for most countries trade is as imperative as production, and the question as to the symmetrical development of the existing resources is beset with additional difficulties. One may inquire whether it is necessary to work any of the resources of a country except the most profitable, buying the other commodities where they can be had cheapest.

For many years the agriculture of the United Kingdom has been allowed to decline, while food has been bought from other countries with the money paid for the products of British mines and factories. This is a natural consequence of the specialisation of modern life, but there is an underlying condition which often seems to have been lost sight of; from which, indeed, it is more comfortable to avert the mind.

Let us look at the case on different scales of magnitude. When the cabbages in Smith's garden are a failure, and the potatoes in Brown's are diseased, the exchange by which Mrs. Brown gets good potatoes and Mrs. Smith good cabbages is a mere matter of domestic economy. When the fire-engine of Ingleglow is lent to save Rodesworth village inn, and the Rodesworth steam-roller is sent in return to improve the ways of Ingleglow, the interchange becomes a parochial affair. A few more rings of the widening wave bring the interchange of coals and manufactures for food and raw materials into contact with international politics. Here geographical considerations which were unnoticeable in the transaction of handing a basket over the garden fence, and not very important in passing from village to village, become clearly recognisable. As long as amicable relations last there is no reason why each district, however small or large, should not produce only the products which suit it best, and trust to trade to supply all the rest; but when dissensions set in Mrs. Brown will run the risk of having no potatoes, and the whole village of Rodesworth may perish in flame, while the manufacturing and mining country may be starved into subservience by a jealous rival. The myth that lapse of time and growth in civilisation make war impossible prevailed at the millennium of Christianity in 1000 A.D.; it was accepted as a demonstrated truth at the first international exhibition in 1851, and the Peace Conference of 1899 may have been taken seriously by some people at the time. Events have shown in every case that war is an eventuality which can never be disregarded; and the usages of international law are not to trust to in a struggle of the life and death of nations.

Apart from such human and theoretically preventible difficulties there are natural accidents to beware of. Transport may be interrupted by storm, the staple crop may be destroyed by disease, and then the district of one resource must suffer acutely, while that in which several resources have been developed proportionately may escape with only some temporary hardship. The old sugar-growing countries furnish a perfect example of the first case, Ceylon of the second. These considerations show that the development of every separately organised portion

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of habitable land—be it country or colony or island—should be made as complete and all-round as possible, while maintaining the natural advantages given it by the predominance of any one resource. The staple should be the chief, but never the exclusive, production.

The strictly scientific point of view looks to the final results of courses of action, but the commercial point of view must take account of temporary conditions, such as fluctuations in prices, which may ruin one country and raise another to prosperity, without affecting the general balance of the world. The individual is of necessity at the mercy of financial considerations. When the price of copper falls he must shut up his copper-mines; when the price of wheat goes down too low he must grow something else. When, after a time, the prices revive, the miners have gone elsewhere, the works are filled with water, and their restoration is so costly that they may be permanently abandoned; but the wheat crops can be brought back to the field in a year's time. In such conditions it is a question whether the individual should not be supported by the community until the stress in his particular department is over. The Government of a country is bound to take steps to minimise the effects of natural accidents so as to avoid evil results to the country, and no finer instance of such a responsibility being assumed could be found than the treatment of famines by the Government of India. Great commercial disasters, too, have been recognised as occasions justifying public support; the principle is perhaps important enough to be more definitely accepted as a preventive, as well as a palliative, measure.

If the ultimate question is to be how to find room for the inhabitants of the Earth, it would seem right that the main resource of a new land should not be allowed to be worked in such a way as to make impossible the subsequent development of minor resources essential to its habitableness. For instance, if enormous masses of a sulphur ore of copper, or even of gold, underlie a wooded and cultivable country, would it not be wrong to work that ore to such an extent and in such a manner as to destroy the woods, sterilise the soil, and leave the place a desert when the ore is exhausted? On the other hand, it would be foolish to prohibit mining in an agricultural country in order not to reduce the ground available for crops; for where corn-land may bear a population of ten per square mile, and supply a large export trade, the mines might enable a population ten or twenty times as dense to find a comfortable living, and form a market on the spot for all the agricultural produce. So far as we can see the age of parochial exclusiveness is past, and that of cosmopolitan equality has not arrived, and the standard by which the development of a region has to be judged at the present day is that of a national policy. Nothing should be permitted in the way of utilising resources which in enriching the individual impoverishes or endangers the interests of the whole community, that is, of the country.

The study of the gradual growth of any of the old countries of Europe shows that geographical conditions, often unrecognised, directed the relation of the people to the land. It is possible to make too much of these conditions, which are only in rare cases sufficiently powerful to override all other considerations, and actually to dictate the order of

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development; but it is more common to make too little of them. The most powerful of all geographical conditions, the fundamentally geographical condition, is the relief of the land. This brings to the surface or buries beyond reach mineral wealth, acts directly upon climate, conspires with climate to influence the nature and distribution of native plants and animals, and all together form an environment which moulds and directs the growth of human communities.

To take a familiar instance: the people of the mountains differ essentially in their manner of life from the people of the plains. Small communities grow up in separate mountain-valleys practically under the same natural conditions, but shut off one from another and left to develop independently. The hunters and crofters of each group of valleys naturally organise themselves into separate clans, at enmity or allied with each other as the case may be, and very similar in organisation all over the world, whether in the Highlands of Scotland, the Caucasus, or the Himalaya. All are at one in viewing the property of the plain-dwellers as lawful spoil, and raiding as a natural calling. Later, such clans naturally tend to confederate while retaining complete local autonomy, as in Switzerland, unless compelled by external forces to assume other forms. On the plains small communities could not keep wholly apart, unless separated by forests or marshes, and thus the agriculturists of a fertile plain tend to coalesce into larger political units, and to give rise to countries of great size, reaching from the sea to the mountains, or to some great river. They have few natural strongholds to help them to become a law to themselves, and so in mutual self-defence they come to live at peace with each other, and exchange the valour of the warrior for productive industry and trade.

The influence of land-forms is indirect as well as direct, acting even more powerfully through the control of climate than through the mere physical bar to intercommunication. The wet seaward slopes of a country in the temperate zone naturally become better adapted for green crops than for grain, which in turn flourishes on the more sheltered land of moderate rainfall. Again, the dry climate of the heart of a continent, or in the lee of a great mountain range, is as a rule only available for grazing and favourable to a nomadic life. Thus the native peoples who have grown up in different stages of culture on the great plains of North America, the Pusztas of Hungary, the Steppes of Russia, or the semi-deserts of Mongolia, are curiously alike in their manner of living and in the elements of their social organisation.

It is chiefly, however, in their influence on the sites of settlements, and the lines of communications, that geographical conditions have shaped the old countries of the world, acting continuously and gently on countless generations of different race, and, in spite of the apparently revolutionary changes due to conquests by alien peoples, these causes have as a rule continued to hold the old villages and the old highroads to their ancient sites and tracks. The town grew up round the rock which gave a defensive position to the stronghold of the protecting baron, or it clustered on the level shelf of a raised beach or river terrace round a deep and sheltered inlet of the sea, or at the highest point up-stream

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which the ships of the period could reach, or it grew beside the ford where prudent travellers arriving at nightfall wished to stay when the river ran high before risking a crossing, or at the mouth of a valley which led up to a high pass, or in the middle of a gap across a narrow range, or perhaps on a strip of water-bearing rocks where wells could be readily sunk for domestic supply; or the site might be fixed by the occurrence of valuable minerals or perhaps by water-power. This natural law of selection as applied to sites for settlements accounts for the fact that even in England to-day, though the average density of population exceeds 500 per square mile, there are large tracts where one may travel on foot for hours without seeing a house, and where villages are nearly a day's journey apart. And there are places where the villages are strung together on some narrow belt of a particular geological formation—such as the Upper Greensand in the Weald —like beads on a necklace, or where the whole surface of some outcrop—say of the Coal-measures—is covered with town joined to town as with a carpet.

Roads arose either from the widening of footpaths skirting the fields from village to village, or they were constructed to join distant points of particular importance, running straight across the open plain, or clinging to the bare ridges of the Downs so as to avoid the woods and marshes of the low ground, or winding through the gorges of a river valley to cross a stretch of broken country, or climbing by laborious zig-zags up the side of some wall-like range. The trunk-roads of a country usually follow the great structural lines of the land, either the thalwegs or the watersheds. Upon the trunk-roads settlements spring up where travellers find it convenient to halt, or the people of adjoining hamlets to meet for trade. The chief street of such towns is formed of the road itself, the High Street, and so the roads built to connect great cities are themselves the cause of the growth of smaller towns.

When railways began to take the place of roads their tracks were less dependent on local conditions. The hill which the road had to turn or cross was tunnelled by the railway; but in old countries the railways have to serve towns which the roads had created, so the main lines of the two systems are rarely dissimilar, though their track is more direct and their gradients easier. The sterner features of regional relief control railways like any other means of communication. In rough country the rails jostle the old road and the older river through narrow valleys, or wind along the sinuosities of the coast-line, or skirt rugged hill-slopes in search of an easy crossing.

In an old country everything has grown gradually, each new thing has been grafted upon that which it was about to supersede. In domestic lighting, for instance, the candle gave place to the oil-lamp, and oil to gas, and gas is yielding to electric light, each new advance being hampered and often rendered nearly useless by restrictions arising from the old. The amount of capital locked up in the results of the past prevents the free adoption of the advances of the present. Vested interests form one of the strongest barriers to the development of an old country. It is evident that new countries can and must be developed on different lines from those which led to the slow advance of

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the old. The trail of the first few pioneers must be followed by the railway, and the road may often be omitted. The candle is followed directly by a complete installation of the electric light; the first rough wagon to jolt along the half-made streets of a new town is followed by an electric railway. The latest machinery is introduced at once in agriculture and in every budding industry, so that a single year may see a larger population established and a firmer hold taken of the land than a century would have seen under the conditions of a thousand years ago. One is tempted to believe that these great advances in invention and application have overleaped, and may ignore the barriers which controlled the old wayfarers and handworkers. This is not the case however. The primary control exercised by land-forms, and the secondary control by climate, are there just as they always were, although their action is to be measured by the standard of cost rather than by that of possibility. A town can be founded and a railway can be built anywhere, if sufficient money is available for the purpose; but the town will not be prosperous and the railway will not pay unless the site of the one and the route of the other have been chosen with reference to geographical conditions. When the British Isles were colonised a knowledge of the principles of geography was unimportant, for events moved so slowly that the slight differences of the resistances opposed to progress afforded sufficient guidance; and when a mistake was made, the result affected only a small district and a few people, and was easily retrieved. Now things are done so rapidly and on so large a scale that a mistake involves very serious consequences and may affect a vast number of people. The failure to dig a canal in Saxon England was never very far-reaching in its effects; but the failure of the Panama Canal Company was one of the great catastrophes of the world. Such mistakes can be avoided by studying the natural conditions which will come into play, and, as a rule, engineers recognise this, and found their plans accordingly.

The blunders made by statesmen in attempting to draw international boundary lines so as to be capable of demarcation and to secure a fair division of natural advantages have been frequently held up by the geographers of all nations as terrible examples of the workings of geographical ignorance. A definite, practical, and easily demarcated boundary is absolutely essential to the tranquil development of a country with neighbours. Such a deplorable muddle as the boundary of Alaska, and such futile suggestions as those which were made for the boundaries of British Guiana, could never have been if the statesmen who were responsible had consulted geographers and had acted on their advice. But within a securely marked boundary the necessity of following a scientific method of development is equally urgent. While the blunders of governments have been held up to the light, it is pleasant to be able to refer to many acts of far-sighted policy, such as the magnificent survey of India, the charting of the coasts of the world by the British navy, the censuses of the United States, and the geological surveys of almost all British colonies and American states. Still, these measures are not always as well supported as they are planned.

We may suppose a great new country just appropriated by a

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civilised Power, and about to be opened for exploitation, and try to indicate the manner in which geographical principles and past experience seem to require that such a country should be developed. There should be at the outset a central government of educated men with no personal pecuniary interest to serve. If it is decided to develop the land by means of great commercial companies, such companies should be strictly confined to their own work. Data for computing the risk of putting a company in possession of great political and territorial powers, and the expense of buying them back, may be found in the history of India, Canada, and South Africa.

It is the duty of a government to know its country. Surveys are of the very first importance, and it would be a good investment to make these thorough. A trigonometrical network should be laid down first, with the smallest number of triangles of the greatest size possible to cover the country and fix the exact position of important points on the coast and in the interior. The large triangles form a framework on which to base secondary triangulations and fill in the detailed survey. The detailed survey should be topographical and aim at providing a map of the country on the scale of at least 1 : 50,000, or say the familiar and slightly smaller scale of one inch to the mile. Lines of levels should be run so as to enable the important features of vertical relief to be shown accurately by contours. The work with modern photographic methods should progress very rapidly in a country where there are only natural features to map, and no roads, buildings, or bewildering parish or county boundaries to be hunted for and laid down. The expense would necessarily be heavy, but not so heavy for a large survey as for a small war, and a timely survey may be the means of averting or greatly shortening a campaign. If the survey of British South Africa had been begun in 1820, or 1840, or 1860, or even 1880, and pushed forward with the ample supply of trained men the British Ordnance Survey could have produced, a war within its borders would be simpler, safer, and immensely cheaper in 1900. Such work in developing a country might with justice be made a charge on posterity by the creation of a national debt.

The survey when completed should be made the basis of all land transfers, as in Australia; the large scale necessary for cadastral maps in old countries is not required when the parcels of land are large and divided by straight lines at right angles, as in the American township plans. When small plots have to be transferred, a special survey of a small square on the land map could be made and registered without more expense than the routine legal formalities demand in old countries. The boundary lines of the subdivision of a country (*e.g.* into provinces and counties) should as a rule be meridians and parallels, or at least lines staked out to represent these, for it would be monstrous to have to shift boundary lines by a few yards if a more accurate determination of longitude showed that they were not quite in the intended position. In certain cases where there are natural boundaries such as a lake shore, a wide river, or a definite mountain range, the larger boundaries might advantageously follow these.

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As each sheet of the topographical map is completed, the area it represents should be surveyed for its geological features, and the geological map produced with the least possible delay. In subdividing land into provinces designed to be ultimately units of local administration it may be well, if the relief of the land does not demand a different course, to draw the boundary lines at right angles to the prevailing line of strike of the strata, or to the coast line, so that each province will share the full variety of the natural resources. This was done by natural selection in many places in the old world. For instance, the communes surrounding some of the Hungarian lakes are divided by boundaries radiating from the water's edge, each commune having an equal share of the coast line and widening inland. So also in part of the Weald district the parishes are long and narrow, crossing the strike of the strata at right angles, and securing to each a strip of sheep pasture on the Chalk Downs, a strip of dry but water-bearing rock suited for a village-site on the Upper Greensand, a strip of stiff arable land on the Gault, and a strip of rough cattle-pasture on the Lower Greensand, where the river runs with its water carriage and water power. Such an arrangement adopted in a new country, when the geological features favoured it, would help to secure a uniform distribution of population, with every kind of occupation represented in each unit, and prevent the high specialisation and one-sided interests of a population exclusively mining, exclusively agricultural, or exclusively industrial. In order to lay out boundaries with reference to these features, it is necessary that at least a preliminary geological survey be made before settlement on a large scale is encouraged, so that the population which is introduced may be of the kind likely to benefit most by the resources and to develop the country in the most advantageous way. The practical value of a geological survey with regard to mineral resources is understood and acted upon in all countries; but it is rare to find such surveys carried out with the good equipment they deserve.

No less important is a hydrographical survey of the coasts. All dangers to navigation should be sought for and discovered without the intervention of the shipwrecks which have charted the coasts of the old world. The natural harbours should be sought out and their relation to the land lines of communication studied so that expensive artificial harbours may not be built in ignorance of the existence of a better haven. The best sites for lighthouses also should be fixed and marked with beacons to be superseded by proper lights when the increase of trade demands it. The hydrographic survey should not stop at the coast. The streams and lakes also deserve to be surveyed, and accurate data obtained not only of the navigability of every river, but of the volume of its water at different seasons, the slope of its bed, the rapids or waterfalls with the available horse-power of their energy. The government of Finland has made such a survey and issued a map which is of high importance in a country without coal. The exact relation of the level of the river-bed to the surrounding country becomes vitally important in the deltaic lands near the mouth where floods are often to be feared and have to be guarded against by extensive works, and also in arid or

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semi-arid regions where the possibility of irrigation may be the touchstone of prosperity.

A climatological survey is another important desideratum, which has hitherto been much neglected even in well-peopled lands. It is not enough to equip a number of stations with instruments for observing temperature, rainfall, pressure, wind, and sunshine. The stations must be frequently inspected, and the observers kept up to the minimum standard of efficiency, and the stations must be placed in carefully selected positions so as to take account of the different local climates of a country. Good observations have to be collected for at least ten years, and often much longer, before any values which can be trusted to show the average climatic conditions can be secured; and once these are obtained the necessity for maintaining the meteorological service is not diminished, but increased. It becomes more easy every year for the central office to forecast the approach of changes of weather; and once the habitual storm-tracks of a country have been discovered, the establishment of a few additional stations in the places thus suggested may be the means of greatly improving forecasts and adding to the security and prosperity not only of fishermen and seafarers, but of farmers and miners. How important an extensive system of rain measurements is in some new countries appears strikingly in the common Australian calculation of converting inches of rain into number of sheep or even pounds of wool per acre. The part which the configuration of the land or its degree of cultivation plays in influencing local climate has never yet been fully discussed for any country, although such attempts in that direction as have been made on a small scale show that the subject is a promising one to pursue.

Further, a biological survey may be undertaken. The distribution of forests, and the nature of the trees composing them, ought to be accurately ascertained. Much of the prosperity of a country depends on the maintenance of a proper proportion of the surface under wood; and an enlightened system of forestry will tend not only to keep the supply of timber continuous, but to maintain the regular flow of rivers, and thus the fertility of the cleared land. In selecting lands for clearing in countries covered with natural forest care should be taken to distinguish between the areas which will yield good agricultural land and those which are fit for forest trees and nothing else. The kinds and habits of fish and land fauna should be studied by the government of a new land in time to prevent the extinction of useful species, and the introduction of species that might prove hurtful.

It is not necessary that the various surveys mentioned above should each have a separate and costly organisation. One field-party, selected so as to contain a few specialists and several general assistants, could attend to all departments of the land surveys. The main thing to secure is official recognition and adequate provision for such work, which is indeed often permitted as a sort of concession to the non-professional hobbies of surveyors.

Next to the stock-taking of national resources, the development of a country demands the provision of a serviceable system of communications.

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To plan such a system requires the solution of a difficult problem in practical geography involving the foresight of probable town-sites and centres of population. The main lines of communication are usually supplied by the river-systems, either as lines of navigation or channels for roads and railways. In a temperate country it is natural to find convergent lines of communication closing in at the head of sea-navigation on a great river. Such lines, whether for water or land carriage, require to be completed artificially across the watersheds linking the various river-basins landward, and a final line to join together the towns which will arise along the coast would complete an ideal outline. As time goes on the great arterial lines of communication would be inter-connected at numerous points according to the exigencies of trade; but while the initiative and support of a government are necessary for the great trunk-lines of the framework, the subsequent completion may safely be left to private initiative. River valleys are not the only natural lines of communication. In some types of country the watersheds offer superior advantages for roads, as, for instance, in New South Wales; or some peculiar geological formation, like the great line of eskers parallel to the south coast of Finland, may compel both road and railway to occupy a ready-made track.

The advisability of considering general principles in planning a system of communications for a given region is sometimes prettily demonstrated by the absurd schemes which are put forward for railways to reach any place which comes temporarily into prominence. It is shown also by the frequent construction of two railway lines in a district which could quite well be served by one.

All navigable inland waters should be brought into connection with the general system of communications of a country as early as possible, for a light-draught steamer plying on a river becomes a good pioneer of a railway line. The placing of stations along a new line of railway should be regulated by regard to the natural converging points for roads, even if roads do not yet exist; attention has also to be paid, of course, to the proximity of supplies of water or fuel. The device of running the main trunk-roads in a system of rectangles is contrary to nature, and apt to result in unhappy gradients even in easy country. The main roads should run in harmony with the natural lines of the country-side, a mile or so of increased distance being balanced by easy gradients; but there is no reason why a rectangular system of bye-roads to connect adjacent settlements should not be associated with natural high-roads.

Every type of land-surface requires its special system of road location. As a general rule, the less engineering that is necessary, the more commodiously will the road perform its function of opening up a country. But, of course, exceptional cases demand exceptional treatment. On a dry level plain the roads may run straight from point to point; over a rugged mountain region which is only a barrier, it is often a question of relative cost alone whether a line will cross through a tunnel or wind over a pass; but as a rule the lie of the land should determine the line to be adopted.

In a new country the sites of towns are usually determined by the

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positions of the most convenient harbours, the junctions of lines of communications, and the neighbourhood of extensive mineral resources. In the course of natural development the village or the town comes before the province, which is rarely a natural growth. But in many new lands the provincial boundaries are first drawn, and a centre of administration has to be placed somewhere within the area. It is by no means necessary to have this centre in the middle of the province; in fact, nothing is more striking on the political map of any continent than the non-central position of the capital of almost every country—Madrid is the only conspicuous exception.

The practice of planning out towns in rapidly growing countries on one common chessboard pattern has many points in its favour. It is simple, allows of easy registration of building lots, and a stranger can always find his way about. The plan, however, is only adapted for level or slightly undulating sites. A town ought to be planned and built for a site as carefully as a suit of clothes is measured and made for a man. A rectangular plan for a triangular site at the junction of two rivers, or in an amphitheatre of hills rising from a bay, or in a narrow mountain valley, is a misfit, and can never be either comfortable or convenient. It stands to reason that on a broken site one set of streets should run nearly in the curves of contour-lines, keeping almost to one level, with just slope enough for ready drainage, while the connecting streets descend the slopes not at right angles, but obliquely to reduce the gradients. Planned thus, a town acquires distinctive character from its site, and avoids the shame of rectangularly intersecting streets, each horizontally straight, but undulated like a switchback railway, or perhaps with its row of houses broken here by a bridge over a gorge, there by a face of rock in a deep cutting. In selecting the site for a new town the questions of drainage, water-supply, and security from risks of flood or landslips have all to be taken into account. From the neglect of one or other of these precautions new towns have time after time been failures. The familiar unhealthiness of new goldfields is usually due to the complete neglect to provide any system either of drainage or of water-supply, and these are only acute instances of a chronic defect in the growing towns even of the most progressive colonies. The question of sewage disposal is quite as urgent a problem in a new community as in an old one; and there is the less excuse for neglect where one can start from the beginning with the experience bought by more deaths than have occurred in all the battles of all ages.

The last and most important element in the development of new lands is the introduction of the right sort of people to inhabit them. The chief difference between a new land and an old is the more primitive character of the former, and thus one might be tempted to suppose that the best type of inhabitants would be those who care least for the comforts of life, and are least dependent on elaborate methods of working. But in a new country, where labour is scarce and dear, every labour-saving contrivance must be used, and the best machinery is worth obtaining, so that adaptability to new conditions and intelligence to make the utmost use of the latest advances count for much. The farmer

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who at home still looks upon steam machinery as "new-fangled" may find himself confronted in Australia by sheep-shearing machinery run by electric power. At the present day it would be hard to find in any developing colony the four-armed windmill against which Don Quixote fought, but modern wind-motors on their lofty steel shafts are common. New lands must be developed by modern methods, and the best type of man who can be found is not too good for the work. The desirable qualifications are to be strong, practical, educated, and open-minded.

From the point of view of government the new lands of the temperate world are almost equally divided between, on the one hand, the autocracy of Russia as exercised in Siberia (which contains more than half of the new lands comfortably habitable by Europeans), and on the other the republican governments of the United States and South America, and the no less liberal forms of self-government followed in the British colonies of Canada, Australia, and South Africa. The new lands of the second category have become refuges for people subject to political or religious disabilities at home, and so are gathering in amongst a prevailing Anglo-Saxon population a mixture representing almost every European race. There can be no doubt that new racial types are now developing in the environment of the new countries by the grafting of branches of every variety of the white type of mankind into the prevailing Anglo-Saxon stock. It is a healthy sign that in almost all new countries efforts are made to prevent the intrusion of undesirable immigrants, while those who are suitable are welcomed regardless of race or creed.

While the future of the new lands now undergoing development is more in the hands of the people who are carrying on the work than was ever the case before, the necessity of state guidance and help at the outset was never greater. The whole community recognises the necessity of a complete system of communications, of holding and administering the vacant lands as the property of the state until required for allotment, of keeping order in thinly settled districts and amongst the shifting crowds of mining camps, of assisting and encouraging agriculture, and generally aiding in the development of the country by an expenditure of capital which could in no other way be obtained without the establishment of monopolies that would hamper the free enterprise of individual settlers.

Of all the methods by which governments assist in developing new countries, the most important is perhaps the promotion of irrigation works. It is believed, although the evidence on the subject is perhaps not yet conclusive, that a gradual process of desiccation is going on in all the continents, diminution of rainfall and increase of evaporation leading to the extension of deserts and the sterilising of steppes. The fact at least is certain that in every continent there is a vast area of arid or sub-arid land, the rainfall on which is insufficient for any form of agriculture, or even of good pasture. The great plains which stretch along the east of the Rocky Mountains from the borders of the sub-arctic forest to the Gulf of Mexico, the pampas of Patagonia, the high veldt in South Africa, the whole interior of temperate Asia, and almost the whole continent of Australia require only a water supply to become permanently

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productive lands. The works required for irrigation on a large scale are too costly, and involve the treatment of too great an area of country to be undertaken profitably by individuals or even associations. They require geographical changes of the first order: the construction of reservoirs as large as lakes, the diversion of rivers where they flow full and perennial from the mountains, so that instead of reaching the deep-sunk beds which literally *drain* the country, they are made to flow at the level of the general surface, above the valleys towards which the water must be trained to flow through irrigation channels which vivify the land. Already governments have begun to bestir themselves in this direction, and the irrigation surveys of the United States are a fine example of what can be done. But every land surface has its own intimate character, the treatment of which must be, if one may so put it, personal to itself, and methods successful in one place may not prove to be equally applicable to another. This is indeed true of all efforts to develop land; imitation of work accomplished elsewhere is not enough, every region must be studied in itself before the appropriate treatment can be prescribed.

Many complications arise in the development of a country which require to be faced and dealt with. No land can be looked upon as absolutely "new"; some one has been there before, and some artificial disabilities have to be contended with in addition to those arising from nature. Amongst these the most serious arises from the presence of aboriginal inhabitants of a low grade of culture. Such primitive peoples are dangerous in many ways. They may resent the settlement of their hunting-grounds and make reprisals on settlers for the loss of their game, as in Australia; they may cause the deterioration of the superior race by intermarriage, as in South America; or, without going to either extreme, they may lead to constant irritation and slow degradation among the settlers on the outposts. It is rarely that native races make good workers. Sometimes by careful management small communities are trained to work in civilised methods and show great aptitude for special callings; for instance, the Indian pilots who steer the steamers through the rapids of the St. Lawrence. Frequently the contact of white and dark races results in the rapid extinction of the latter; but there are cases where the compulsory preservation of peace between native tribes leads to a rapid increase of the coloured population, as in Natal. The problem of the treatment of the subject races is very difficult. The spread of a knowledge of reading and writing, or the adoption of Christianity, does not necessarily fit the native for self-government; and however widely the political suffrages of a country where white and coloured races live together may be drawn, means are usually found to prevent the exercise of any real political power on the part of the latter. It is a question worth discussing whether a frank recognition by the administration of a state of matters which exists might not be a sounder policy than that of proclaiming equality before the law and allowing the proclamation to be nullified by the force of custom. There is no doubt that by wise treatment from the beginning native races might preserve their self-respect and be brought to occupy

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a useful position in the growing life of a new country. But it is unfortunately rare to find a native race unhurt by premature contact with the scum of white society which floats over all the world in advance of the wave of worthy settlers; and the mischief once done is hard to repair. Again and again since the first great successes of the Jesuits in South America Christian missions have succeeded in bringing isolated native tribes into a state of industry and happiness, without loss of health or vitality; but if there are any cases of primitive peoples brought into a state of civilisation high enough to enable them to resist deterioration by contact with degraded whites, they must be very few.

The civilisation of the white race is the result of long development in conditions which have been gradually changing; and it is now being generally recognised as unreasonable to expect to bring races, inferior at the start, to a high plane of culture in a few generations. The development of new lands must be viewed from the point of view of the European conquest of the world; and it is mere affectation to pretend that native races, handicapped by an inheritance of intellectual and moral inferiority, can be placed at once or soon upon an equal platform with the white. That exceptions exist it is a pleasure to recognise, but the rule prevails. If it is necessary to impress on people at home the folly of treating prematurely and superficially civilised tribes as equals, it is unfortunately even more necessary to warn white settlers in distant lands of the wickedness of treating the aborigines as people without rights. The criminal brutality of white settlers with regard to natives is a scandal usually denied in print, but frankly enough acknowledged in conversation. It should be the business of every government to secure the right of all natives to undisturbed possession of a sufficiency of good land, and to see that the punishment of natives for crimes which they do not understand should be on a more lenient rather than on a heavier scale than the punishment of similarly-offending whites. It is not difficult to secure the passing of excellent laws on this subject, the difficulty lies in their application.

A problem of another kind arises in many cases from the conflicting interests of new immigrants in a country and the descendants of earlier settlers, perhaps of a different European race, who have grown into harmony with their new surroundings, but cling to old ideas which the newcomers have outgrown. It has recently been fashionable for newspapers, even those of the highest standing, to fan the ever ready flame of racial antipathy, and the blame for this can always, and usually justly, be thrown by either party on the other. In time, with a good deal of mutual forbearance, these dissensions die away, for the newcomers in their turn take the colour of the country and adopt the resultant mode of life. The accentuation of racial troubles may perhaps be usually referred to periods during which the rate of immigration is too rapid, and the newcomers have not had time to acquire that adaptation to their new conditions which would bring them into friendly touch with the earlier occupants. These too require time to recognise that they must allow new methods of development of the land which they have been accustomed to ignore or despise. Such dissensions, painful and disastrous

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as they sometimes may be, are mere episodes in the process of adjustment to environment which is always going on, and always tending to a condition of ultimate equilibrium. The rebellion on the Red River in Canada in 1870 may be traced to this cause, and it has led to the result indicated by general principles. The applicability of a similar line of argument to the present position in South Africa need not be insisted upon.

Settlers in a new land become, at any rate in the second generation, creatures of that land; and although they may maintain the most cordial and loyal relations with the country of their origin, they are bound primarily to their adopted soil. No land can be fairly developed by people who merely wish to snatch a fortune or a competence from it, and go elsewhere to spend it. This is perhaps one secret of the failure of chartered companies in their political character. It is impossible to transport a nation to a new land; the result of anthropogeographical study is to show that in a new land a new nation is developed, the power and influence of which in the world's history does not depend upon maintaining old nationality, though it depends largely on retaining old sympathies. Who can say that New France has lost in any degree in becoming Canadian; or that New England is less influential since it became American? The grip of the land on its inhabitant is a thing of nature, the source and safeguard of patriotic feeling. Just as the loyalty of a Scotsman is fervent to his narrower fatherland, yet unquestioned to the kingdom and the empire; so through the devotion of the people to their land which grows with time, and not quickly, a real yet a diverse patriotism is arising in every associated unity of the British empire which will hold it together in virtue of the common sympathy until in some distant age it enters as a majestic unit into the wider "Federation of the World."

MILITARY GEOGRAPHY: A REVIEW.[1]

It has been not inaptly said that "Geography is the science of conquerors." This general statement may be taken to include two interdependent propositions. The opening up of countries by invading hosts has enabled us to acquire a knowledge of their configuration, of their population, of their resources; but at the same time an antecedent accurate knowledge of the area involved is absolutely indispensable in order to the successful issue of military operations. With both of these propositions we are here intimately concerned. For what is military geography? Nothing less than geography as it affects military operations; geography as it interests, as it should be studied by, military men. Military geography, then, must, if it is to be studied with profit, if it is to inquire into the "wherefore" of things, and not simply content itself with an account of things as they stand, rest on a sure foundation. It

[1] *Outlines of Military Geography*, by T. Miller Maguire, LL.D., Cambridge, 1899. (Cambridge Geographical Series.)

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must reckon geology as its starting-point, as its basis. It is not intended to imply by this that the student of military geography must be a profound geologist; but merely that the results arrived at by geologists should form the substratum on which to build up his fabric. Without entering into the minute division of geography, into an endless array of subdivisions with very new and very long names, as is now the vogue, it will be sufficient for the purpose in hand to say that the student of military geography should not neglect political geography, as it opens up to his view the character, the physical and moral capabilities of peoples with whom he may have to deal, either as a companion-in-arms or as an opponent. Historical and administrative geography, too, form a not inconsiderable factor of our subject, so that the methods adopted and the routes pursued by great and successful generals may appear as examples to follow, no less than the shortcomings of their less successful fellows as examples to be avoided. The study of economic, statistical, and commercial geography will lay bare the relations between the soil and the occupations of the inhabitants, the resources of the country, and the means of transport, etc. Finally—and this is perhaps the most important of all the branches of the subject—mathematical geography will teach the student not only how to read intelligently maps which have already been constructed by others, but also how to construct maps himself. In fact, there is no branch of geography, however long and German-looking its name, from which military geography does not demand some contribution, be it geomorphology, anthropogeography, or what not. "The knowledge of geography in its minutest details is essential to a true military education." This opinion was expressed by General Sherman when writing to a friend and asking for the best geography and the best atlas extant.

Relief is determined chiefly by the nature of the rocks of which a country is built up and by the mode in which they are arranged. Given a region of medium elevation composed for the most part of beds of sandstone, shale, and limestone, dipping in some determinate direction, and a geologist will have no difficulty in indicating what the dominant character of the surface will prove to be. If he knows the geological age of the strata and has reason to believe that the land has been for a prolonged period subject to erosion and denudation, he will expect it to be traversed by parallel ridges and escarpments with intervening hollows. So, again, should the beds be horizontal, the valleys will probably be trench-like, and the intervening heights will form pyramidal and tabular hills and mountains. Once more, should the rocks be highly folded and contorted, and traversed by irregular masses of igneous origin, such complicated structures are sure to give rise to a highly diversified configuration. A good knowledge of physical geology is thus of essential importance in military education. The changes which take place in the configuration of a country are the result of changes in the nature of the rocks or in the mode of their arrangement. Not only so, but the general character of the drainage of a land and the nature of its soils and subsoils are determined by the same causes. When we know the geology of a country we know what kind of relief to expect, and whether the roads

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are likely to be hard and durable, or soft and readily tramped into quagmires. It is obvious that in preparing a plan of operations on sound strategic lines such knowledge must prove of the utmost value. It is necessary, therefore, that any such plan should be based not only on the topographical map of the area, but also on the geological map. As a matter of fact, when the topographical map is not contoured, the ordinary method of representing hills by hachures or by stumping gives a very poor idea of the relief, and a good geological map, read with even a very slight knowledge of the subject, is of great assistance in forming a general idea of the character of the country.

The Vosges mountains are continued northwards by the Haardt and the mountains of the Palatinate, and there is a regular network of roads between Kaiserlautern and the Hunsrück, whereas in the Vosges proper and the Haardt there are but few; and the network of roads only appears again in the Basses Vosges, a fact of great importance in military geography. Geology tells us that the Triassic strata of the Vosges and the Haardt are massive and continuous, whereas the Pfalzgebirge or mountains of the Palatinate are of an older formation, namely, Permian, traversed by relatively young eruptive rocks. The Permian, being older, is more eroded, while the young eruptive rocks have not been worn down; and we have the isolated hills, mentioned above, round which the roads can wind with ease. Again, the French Jura and the German Jura are composed of rocks of the same age, but here the similarity between them ends. The former have been compressed into more or less steep folds—they are folded mountains—while the latter are tabular, and the effect on the road system is therefore most marked.[1] In the French Jura, as in all folded regions, the soil changes frequently as the strata appear and reappear in constant succession, the breaks are frequent, and the country accidented; in the latter the whole district is characterised by a similarity of soil, and the country is undisturbed by abrupt rise and fall. The Balkans, Pindus, and Dinaric Alps are chiefly of Cretaceous age, and the area has been fractured and invaded by rocks of igneous origin—wide areas being occupied by granitoid and trappean masses. This is so singularly explanatory of the apparent discrepancy in the following accounts of the Balkans quoted by General Chapman in a lecture to the Aldershot Military Society that I give the extract in full:—

"'The Balkan range is distinguished by craggy summits and steep sides, which render travelling difficult and in many places impossible. Most of the narrow roads, of which only a few are passable in carriages, are made in the dry beds of torrents, and the traveller runs the risk of being drowned in them when they are suddenly filled by heavy rain.' This may be read from the point of view of the ordinary traveller; it is, too, a description given by an observer of the northern aspect of the range. I give, in contrast to it, an extract from the journal of an officer who was employed on the Boundary Commission in Roumelia. 'We are now right under the Balkans, and what do you think are the Balkans? Grim-

[1] *La géographie militaire et les nouvelles méthodes géographiques.* Par O. Barré. Paris, 1899.

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looking heights, peaks, and glaciers? Nothing of the sort: great bluff hills of the rolling English down style.'" [1]

Here the eruptive rocks of the Cretaceous system form the bold portion. That part where they are not present is the water-worn down country. The existence of this difference would be shown at once by a geological map. It is of interest at present to note that the country to the north, south, and west of Ladysmith is a Carboniferous district in which the limestone of the period gives the prevailing shape to the hills or kopjes. From the few examples which have been given—and their number might be multiplied indefinitely—it will be gathered that an elementary knowledge of petrological and structural geology should be acquired as part of a course of study in military geography, and the subject therefore should form part of any work on military geography. Colonel Holdich, alluding to boundary questions, says:—"The widest geographical knowledge will prove the best safeguard against misunderstanding. . . . By geographical knowledge I do not mean simply that knowledge of the earth's surface which we gain by surveying it. I mean also a knowledge of those ordinary laws of nature which decide the configuration of mountains and the flow of rivers, where certain influences must inevitably lead to certain conditions." [2]

Let us now learn from Dr. Maguire the first principles of strategy. To begin with, it must be clearly understood that "soldiering and fighting are far from synonymous; that in a campaign combats are occasional, while marching is constant"; that before entering into a battle a general must be careful to secure his retreat. It must be borne in mind that "soldiers, like all other men, require a certain amount of food, sleep, shelter from weather, and clothing," and "wagons carrying supplies must be constantly replenished from the base, or from depôts provided in the theatre of operations"; while "to take the place of men . . . invalided and of the dead"—and, it might be added, of prisoners—"a constant stream of recruits flows from the rear to the front after every skirmish or battle." "Moreover, ammunition is quickly exhausted, and the work of replenishing magazines causes a circulation of waggons backwards and forwards," and "the farther the army marches, the greater become the difficulties."

Again, "the various corps of an army must move not by one, but by many roads to a common object. In some countries these roads may be near one another, in others they are more distant. In some countries they are separated from each other by rivers only passable by a few fords or bridges; or worse, by ranges of hills only to be traversed by a few passes." Further, "any considerations of strategy that apply to ordinary roads apply to railroads with greater force; they facilitate supply and movement tenfold." The roads must be both many and good, and a bad road becomes worse than useless in bad weather. A line of operations, that is, the line or lines of communication by which an

[1] *Physical Geography in its relation to Military Operations.* By Major-General E. F. Chapman. Aldershot Military Society. No. xxvii. 1890.

[2] *Geographical Journal*, 1899, No. v. p. 467.

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army advances towards its ultimate object, should be so chosen that not only may the troops be kept together as much as possible, but that the enemy's line of retreat may be approached as closely as possible, while at the same time the line of operations may be as near as possible to our own line of retreat. It must be constantly borne in mind that "as an army advances along several roads its various portions may be obliged to move at some distance from each other, and that if they cannot keep touch on the left and right flank respectively they may become so separated in a few days as to be practically two distinct armies"; while if they have started from different bases, they will develop eccentric or divergent lines of communication. In this case all the advantages of their superior numbers may be lost if the least hitch in arrangement should occur, and they may be beaten in detail." Dr. Maguire duly insists on the importance which attaches to a "threat against the enemy's lines of communication," whether by road or river, by railway or by sea, and of making him form "front to flank," that is, fight with a flank to the base; he also dwells on the vast importance "to the defensive, if inferior in strength, of even a temporary segregation of the offensive force."

"It is of no small consequence to the strategist whether his adversary's front is, with regard to his own, parallel, oblique, salient, or re-entrant," and "a front of operations," that is, the space between the strategic fronts of two armies, "is dangerous from a strategic point of view, unless it is developed behind one or more important obstacles"; unless it is covered by some artificial defence or natural support on both wings; unless its extent be proportionate to the forces which defend it in line of battle, and these forces can support each other at a critical moment; unless it covers the line of retreat; and lastly, "unless, if retreat be necessary, there are behind it, within convenient distances, good positions for battle."

All these points, as well as the subject of secondary bases, in case an army advances far into hostile territory, and the question of detaining forces, are lucidly treated by Dr. Maguire, with abundance of historical illustration; and, after stating Hamley's definition of strategy, he sums up the matter thus: "The object of a strategist, in drawing up his plans, is so to arrange his marches and his lines of operations that, on the one hand, if he wins the battle, he will not only defeat the enemy in the field, but place him in a situation of much perplexity as to his future actions, his line of retreat, and his supplies; and, on the other hand, if the battle be lost, he will have secured for himself a safe line of retreat and an opportunity of recuperating himself."

It is abundantly evident, then, from all this, that the strategical plan of operations must be settled as long in advance as possible, and will depend chiefly on a study of the maps of the selected field of operations; but there must be no rigidity in this plan. It must, at least, be sufficiently elastic to permit of modifications and variations during the development of the campaign. Among the chief points to be attended to will be the selection of suitable localities for magazines, depôts, and hospitals. Plans of the lines of march of the various divisions must be elaborated and so

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arranged that the various divisions cannot become entangled. Towns and villages for cantonments must be chosen, and suitable sites for camps selected, and the resources of the country accurately gauged, as the supplies required by armies in the field are simply enormous. We need go no further than the present campaign to exemplify this. We read that with regard to the march of the field force, on 11th January, from Frere towards the upper Tugela *viâ* Springfield, "The united force comprises, *inter alia*, much artillery, including the 61st Howitzer Battery. There is also a considerable force of cavalry and mounted infantry. . . . With the force were four hundred wagons and five thousand transport animals, the whole extending some nineteen miles in length."[1]

But in addition to strategy, which Dr. Maguire enters into fully, we must further touch on tactics (which he does not deal with) inasmuch as military geography is as intimately connected with the one as with the other. Tactics may be defined as the employment and manœuvring of troops when in contact with, or in the presence of, the enemy. We see, then, that the general plan of the campaign and its objective are strategical considerations; the carrying out of that plan belongs to the province of tactics, including the operations by which battles, due to the collision of armies, are fought, as well as the smaller operations of war, such as outposts, the action of advanced and rear guards, the selection of positions for hasty entrenchment, and the mutual co-operation of the three arms to attain victory, and, above all, so far as military geography is concerned, reconnoitring.

Before proceeding to the consideration of the maps, it will be advisable to have a general idea of the effect on strategical and tactical operations of the chief physical features. Mountain chains, if they are of the first order, such as the Himalayas, or, in Europe, the Pyrenees or the Alps, form an excellent frontier from a defensive point of view, because, as a rule, the number of passes by which they may be crossed will be small; and their defence is synonymous with the defence of these few cols and defiles. From an offensive point of view they are of equal value to the two countries concerned, unless one slope be short and the other long, when the forces of the one would, after the actual passage, emerge on a plain, while the other would be shut up in narrow and restricted valleys. A good example of this state of things is found in the Alps and the plain of the Po. Of course it must be clearly understood that the chain of mountains, to be of value as a frontier, must not be capable of being turned. The Vosges mountains, for instance, could easily be turned, and consequently no effort was made to defend them in 1870.[2]

The difficulties which a really mountainous district, such as Switzerland, the Tyrol, or certain parts of Spain, present to both the offensive and defensive, are very great. There are few practicable roads, and the progress of a large army is therefore rendered very difficult. Moreover

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[1] *The Times*, 20th January 1900.

[2] *Géographie militaire*. Par le Commandant de Génie A. Marga. Paris, 1885. Vol. i. p. 22.

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such a region is naturally poor in provisions, and the necessary columns of supply further hamper the strategic movements of the force. In such a district the advantage of superiority of numbers is lost, because the deployment of large numbers is impossible, and therefore it can only be the theatre of a small war. On the other hand, such countries are easy to defend, if care be taken to secure the retreat; and this point cannot be too strongly insisted on, for the more easy a front is to defend, the more secure must the means of retreat be made, because in mountainous districts the only method by which the offensive can arrive at a satisfactory result is by turning movements.

Considering, now, the tactical side of the question, it is a maxim well known to military men, that knowledge of the terrain is the foundation on which all such operations rest, and therefore a study of the great topographical surveys, if the operations in question be in a country which has been so mapped, becomes a matter of the very gravest importance. In hilly or mountainous country, one of the first points to which the tactician must turn his mind is the slope at which his various arms can move, and this slope he will read off his contoured map, so that he will be able to tell at a glance how the troops may be employed to the best advantage. From any work on tactics some such figures as the following can be culled.[1] Up to 3° rise the ground is, for military purposes, considered level; a rise or fall of 5° (1 : 11) in no way impedes the march of troops, but is the limit for a cavalry charge downhill; at 8° (1 : 7) heavy wagons cannot ascend without extra horses, and movement becomes very fatiguing for infantry; a slope of 10° (1 : 6) is difficult for artillery, and the limit for cavalry charges uphill; if the slope be over 15° (1 : 4), infantry cannot manœuvre, field guns can only move with assistance, and cavalry can only trot uphill for a short distance; from 25° to 30° all employment of formed infantry ceases, and only single skirmishers can ascend such steep slopes climbing; above 30° no more military use can be made of the ground.

In hilly ground that cover from fire and view can be obtained, which is nowadays so all-important, while the party in possession of the heights has a command of observation over the surrounding country. The effect of fire, too, is greatly influenced by hilly country, the fire becoming plunging, grazing, etc., according to circumstances; the lateral range also of artillery is affected by the view. The relative heights of hills is also of very great importance, in the selection of heliographic stations, and the question whether one hill commands another may be of serious moment. The following extract from a telegram sent by General Buller to the Secretary of State for War, emphasises this and some other points:—

"Warren holds the position he gained two days ago. In front of him, at about 1400 yards, is the enemy's position. It is on higher ground than Warren's position, so it is impossible to see into it properly. It can only be approached over bare, open slopes. The ridges held by Warren are so steep that guns cannot be placed on them, but we are shelling the enemy's position with howitzers and field artillery

[1] These figures are taken chiefly from Demangel's *Questions and Answers on Tactics.*

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on the lower ground behind the infantry. . . . An attempt will be made to-night to seize Spion Kop, which forms the left of the enemy's position, facing Trichard's Drift, and divides it from the position facing Potgieter's. It has considerable command over all the enemy's entrenchments."

A line or row of hills, although affording a large number of positions, where accessible for artillery, and whence command of the adjoining plains may be obtained, is unfavourable, because their summits are disconnected, and therefore the troops holding them are also disconnected; while a ridge or mountain spur, with one continuous crest, is free from that defect. In the present war, however, the lack of connection between the kopjes would seem not to trouble mounted infantry.

"Hilly or mountainous tracts of country represent an intermediate form of ground between a plain and highlands or high mountain ranges proper. The practicability of the ground, though more restricted than in the plains, is generally assisted by fairly constructed roads, and only interrupted at a few steep gradients. Good military positions are here more frequent than in the plains. Highland or mountain ranges differ from mere hilly tracts, not merely in their degree of elevation, but also in configuration. Highlands proper are generally supposed to be of two kinds, viz.: intermediate or secondary ranges (Mittelgebirge in German) and high mountain chains. In the latter the lines of march and communications are confined to roads which generally follow the courses of rivers in the valleys, and lead across the chains and spurs at depressions in them. Human habitations are mostly crowded together in valleys and glens, forming often those long straggling villages one observes in mountainous districts. Small towns are occasionally found at the outlets of the valleys. The quartering of troops is here difficult, and supplies are rarely obtained.

"Secondary mountain ranges frequently offer an effective sphere for military activity, especially in detachment warfare, or when the retreat of a beaten army is to be covered; but the task of preventing the passage of a hostile force across mountain chains is difficult, while positions taken up within the mountains are dangerous owing to the possibility of being turned.

"Infantry will almost exclusively be employed here, cavalry confined to patrolling duties, and artillery restricted to the use of mountain batteries.

"High mountain ranges, owing to their impassability, the difficulty of finding quarters, and the bringing up of supplies, are least suited to military operations. The necessity of having sometimes to cross high mountain chains with armies has caused the construction of several grand military roads, and even of railways; but the mere task of crossing alone—possible only at a few fixed points—is an undertaking involving great exertions and sacrifices."[1]

Plains, on the other hand, are easy to conquer and difficult to protect; a single battle may make you master of them, a single battle may cause their loss. The vast plains of Asia have, from time immemorial, been the theatre of victorious exploits. But Europe is split up by natural obstacles into a number of states of limited extent, each with a considerable resisting force. Conquerors have before now attempted to place the whole Continent under their sway, not without considerable success—Charlemagne, Charles v., Napoleon. But the repartition of their empire

[1] Col. A. Schmid, *The Study of Ground and its Influence on Tactical Operations.*

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has always followed immediately on the death of the one or the other. Switzerland, with its mountain fastnesses, has never been conquered; the same may be said of the Tyrol; whereas the great plain of Poland could not maintain its independence. However, though the mountains of Switzerland are of vast tactical importance, it is not its mountains, but its relative position, from which this country derives its great value, from a strategical point of view. The master of Switzerland can take in flank or in rear the lines of defence of either Germany or Italy; and a French army, debouching from the forest towns, or from the cols of the Central Alps, would have a great strategical superiority over an enemy on the Rhine or in Piedmont.

Strategical operations generally gravitate towards the plains. They are rich in resources, well peopled; here are the great cities and the network of lines of communication; and it is here that great campaigns are generally decided. Once master of the plains, the country is overcome; mountain warfare may continue for a while, but the end is not far off.[1]

Perfectly flat ground is seldom met with, but the term is sometimes applied to country which permits a clear view in every direction, and does not afford concealment to even small bodies of troops. Such a plain does not impede the movements of troops, and therefore does not favour either attack or defence, but would seldom be chosen by the latter unless the choice were justified by a vast numerical superiority, when there might be certain inducements. An open but intersected plain, that is, one cut by canals, streams, ponds, or marshes, but where the view is not obstructed, impedes the movements of troops, and is particularly unfavourable to cavalry. Such country as this would favour the defence rather than the attack. An enclosed plain, that is, one divided by walls, woods, villages, hedges, etc., but free from ravines, ditches, canals, watercourses, etc., may offer opportunities for selecting ground well screened from observation, but this advantage is counterpoised by the restricted range of both infantry and artillery fire. On the other hand, an enclosed plain offers peculiar opportunities for surprises and sudden attacks. When a plain is both enclosed and intersected it would seldom, if ever, be chosen as a field of action, for it is the most difficult of all this class of country, though small bodies of troops might possibly be able to make advantageous use of it.

From a commercial point of view, a great river forms an excellent boundary between two countries; it separates the countries but offers no obstruction to the development of trade; strategically, however, it is not a good frontier, unless one of the parties has possession of both banks, when, in point of fact, it ceases to be a frontier.[2] A river is no real obstacle, strategically, merely a means of communication. But when in possession of both banks it is not necessary to force a passage before taking the offensive. The value of a river as an obstacle from a tactical point of view depends on its breadth, depth, the nature of its banks, and of the surrounding country. The "locality" for crossing a river is fixed

[1] *Géographie physique, historique et militaire.* Par Th. Lavallé. Paris, 1872. Page 17.
[2] *Précis de l'art de la Guerre.* Par le Baron de Jomini. Paris, 1894. Vol. i. p. 355.

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by strategical, the exact point by tactical, considerations; and the question of bridging or fording must be entered into, the relative heights of the banks taken into account, and also the shape of the river itself, so that the assailant's bank may admit of a convergent fire on the other bank, or, in other words, the crossing should be fixed at a re-entrant curve. The Tugela crossing at Potgieter's Drift is a good example of such a spot. The passage of a river, though one of the most frequent, is at the same time one of the most difficult of warlike enterprises.[1] A chain of mountains with a river running parallel in rear and protected at certain points forms an excellent frontier. The Germans have a frontier of this kind in the Vosges with the Rhine; the Swiss, too, have the Jura with the Aar.

A valley perpendicular to a chain of mountains is naturally the shortest road from one slope to the other. The roads over the Mont Cenis, St. Gothard, and Splügen lie in such valleys. If there be several valleys of this kind, all parallel, and perpendicular to the strategic front, the lesser chains in between them will divide the defensive zone into several sections, and also impede the free movement of troops. Suppose, on the other hand, that there be a series of valleys all parallel to the main chain, and of considerable length, and further, suppose that it is necessary, from the nature of the circumstances, that the aggressor must follow these valleys, then the defender is placed at an advantage. If the aggressor's line of march cuts them, the defender can threaten his line of communications. Thus the route from Italy into Germany cuts the valleys of the Tyrol and Carinthia. Looked at from the contrary position, the aggressor who descends into the enemy's country by one such parallel valley can turn the remainder. The Stelvio route along the Upper Adda turns the defensive lines of the Mincio, Chiese, Oglio, Brembo, and Serio. Again, a valley parallel to the main chain may offer opportunities for threatening the heads of several valleys of the opposite slope; in this way a force in the valley of the Durance may successively or simultaneously threaten the valleys of the Chisone, the Po, the Vraita, the Maira, and the Stura, but at the same time runs the risk of having its retreat cut off.[2]

Valleys converging towards a position on a plain favour the offensive, by affording several lines of operations against an opponent, who would have to divide his forces to guard the exits. On the other hand, the defender occupies a central position from which he can advance, with the advantage of numerical superiority, against a debouching force. Valleys which diverge from a point are always dangerous, though they give the advantage of being able to threaten several points at the same time, and offer a choice of routes. Tactically speaking, valleys are more disadvantageous than plains, inasmuch as the disadvantages are doubled, valleys being commanded from two sides. Ravines frequently interrupt the free command over a slope, at the same time affording cover to the enemy and giving access to the crest; they are generally disadvantageous. In the case, however, when a ravine runs straight towards a position, at right

[1] Lavallé, p. 22.

[2] Marga, p. 26.

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angles to it, it can be well swept by fire, and therefore forms an exception. The military importance of a defile, whether it be a valley, a bridge, or what not, is increased when for miles it forms the only access to a tract of country; if, on the other hand, it can within easy distance be turned, it generally loses all value. The Colenso bridge, for instance, was only of prime value when the Tugela was in flood; it lost a great deal of its importance when the river was low and there were fords above. "There is always a danger in fighting with a defile behind the line of battle, whether it be a road through a mountain or a bridge over a river. If the battle be lost, and the retreat be not orderly, the troops will be hemmed in by precipices or forced into the river." "No attempt should be made to carry a mountain defile or strong position on a mountain by direct or front attack, if it can possibly be turned by a flank attack."

Marshes, lakes, and woods are strategically favourable to the defence, and form an excellent frontier line. Marshes as a rule cannot be crossed. The great Pinsk marsh forms a capital frontier between Russia and Austria, and could only be crossed when frozen. Lakes Constance, Neuchatel, and Geneva each form a protecting element on the Swiss frontier. Forests and large woods, if covering a sufficient stretch of country and fairly deep, form a good line of defence, if they are occupied and not traversed by too many roads; thus the forests of the Ardennes form a protecting frontier for France, where it rests on no other natural obstacle. Small woods also favour the defensive, from a tactical point of view, if they are used to support the flank or flanks of a position, or to form a strong point in front; they afford cover from view and partial cover from fire, while the assailant has to advance in the open; at the same time they help to keep the enemy in ignorance of the defender's actual position and strength. But, on the other hand, if a wood be too large to be fully occupied, it has a weakening influence on the defender's position, as it affords the enemy an opportunity of turning the position, and should therefore be held in rear.[1] Tracts of country covered with woods, copses, and the like, often form obstacles of approach. Marshy ground, wet meadows, a clayey soil, and ploughed fields are very difficult to get over, and are unfavourable to fire effect.

We come now to what General Chapman alludes to as the "higher walks of geographical knowledge," namely maps and mapping, in fact graphic geography. All the great topographical surveys of European countries have been done by the military authorities, and primarily for military purposes. Our own Ordnance Survey Department is under the Board of Agriculture, but the Survey is under the superintendence of officers of Engineers. It will be seen, therefore, that this portion of the subject is military geography of a high order, involving geodetic and trigonometrical surveys of the nicest accuracy.

The experts are not of one mind as to the best scale for a military map. If the scale be large, a sufficient area cannot be taken in by the eye, or, in other words, one gets off the sheet too soon; while, on the other hand, if the scale of the map be small, there must of necessity be a corresponding lack of detail. There appears, however, to be a general

[1] Demangel.

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consensus of opinion to the effect that the scale for strategical purposes should not be much less than two miles to an inch, and not much more than four miles to an inch. For tactical purposes, of course, the larger the scale the better, within certain limits. A good general scale, permitting the insertion of almost all necessary details, is two inches to the mile, though for smaller areas, such as would be the field for battalion or company commanders, in order to show all the minute accidents of the locality to their immediate front and flanks, the slight rises in the ground, bushes, etc., in fact any kind of cover, the maps might be on a scale of four or six inches to the mile.

The maps of France best suited to strategic purposes are those on a scale of 1 : 200,000 and 1 : 500,000, or about three and eight miles to the inch respectively. The "mother map" on a scale of 1 : 80,000 is not contoured. For tactical purposes the French have no map on a scale larger than 1 : 50,000, this being simply an enlargement of the "mother map," without the addition of further detail. But the authorities are now clamouring for some such map, and doubtless, in course of time, it will be produced. The German map is on a scale of 1 : 100,000, or about one and a half miles to an inch (and a larger map on a scale of 1 : 25,000 is available for tactical purposes); and the Austrian 1 : 75,000, or a little more than an inch to the mile; but both the Austrians and Germans have a map of Central Europe, covering areas most suited to their particular requirements, on a scale of 1 : 200,000. Of Italy there are maps on the scales of 1 : 25,000 and 1 : 50,000 (one map, the larger scale being used for more important areas), 1 : 75,000 and 1 : 100,000. All these are contoured. There is also a map on the scale of 1 : 500,000, but the relief is here not shown by contours. The Russians have an old 3-verst, and a new 10-verst map, corresponding to scales of two miles and nearly seven miles to an inch respectively, but neither is contoured. The other European countries have similar maps, the usual scale being 1 : 100,000. The Atlas of India is on a scale of four miles to an inch, and the Burma survey is a scale of four and eight miles to an inch, but there are also maps of these countries on larger scales.[1]

Besides the general "lie" of the country, the direction and elevation of the mountains and hills, and the positions of the passes, the direction of the rivers, roads, and railways, and similar information, there is shown on most large-scale maps, either by "conventional signs" or by abbreviations, a mass of detail which is of very great importance from a military point of view, and an intelligent map-reader will glean from the study of such a map not only the details as shown, but also general information obtained by classifying these details in his mind, such as would scarcely be found in the most minute description of the country. As a fair specimen the German map on a scale of 1 : 100,000 will be taken, the maps of other countries giving very similar information, varying with the requirements. In the map of Holland, for instance, there is a large number of signs in connection with the water system, while in that of Switzerland, on the other hand, the mountain and wood

[1] *A Guide to Recent Large-scale Maps.* Intelligence Division, War Office, 1899.

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signs will predominate. On the German map alluded to the signs used in connection with railways include those for viaducts, embankments, horse-tramways, stations, bridges, tunnels, level crossings, halting-places. With regard to roads, there are signs for stone and wooden culverts, embankments, cuttings; and the various classes of roads are distinguished as Chaussées of the first and second class, by-ways and local roads that are unmacadamised, field and forest roads, footpaths and mountain paths for pack animals. There are also special signs distinguishing deciduous, coniferous, and mixed woods, copses, nurseries, and orchards; signs differentiating between heath and dry and wet wasteland, moor, vine-yards, and hop-gardens, parks, and ordinary gardens; there are signs for dams, ditches wet and dry, and for fords. Bridges are shown as made of wood or stone, and there is an additional sign for foot bridges. Steep banks have their special mark, as well as weirs, canals, and locks. Rushes and drained marshland and sand are shown, and also dams of piles. Boat ferries are differentiated as flying bridges and those suited for wagons, and wherries; we have also bridges of boats for railways and floating mills. Signs show whether railway bridges are made of stone or iron, and whether the superstructure is of wood or stone. Again, harbours for boats, quays, dunes, moles, collections of seaweed, lightships, lighthouses, beacons, floating and broomstick buoys—all have their special distinguishing marks. The signs for mills and forges are always accompanied by a description of the business carried on. Watch-towers, ruins, remarkable trees, and old earthworks may all be read from the map, as well as important walls, walls with hedges, rocks, and mines, the description always accompanying the last-named. In addition, there are signs for wells, springs, and brooks, for quarries, gravel-pits, burial-grounds, lime-kilns, and tar-pits. The towns are distinguished as chief towns, county towns, villages with churches, and hamlets with over and under a hundred inhabitants respectively, while country residences and large farms also have their own signs. Among the abbreviations we find those for drawbridges, mills used for draining land, girder bridges, various manufactories, sheep-folds, and smaller details; also for drill and manœuvre grounds, for mills and pits, the various classes of industry being shown. On the larger-scale German maps there are additional signs distinguishing the classes of railways, whether single or double lines, whether narrow gauge or broad; signs for various stone and wooden buildings, plank and lattice fences and hurdles, as well as for heliographic stations. These maps also show whether the means for repairing the road are at hand, and whether the roads are lined with trees, etc.; if roads are unreliable, and the points at which drag-shoes should be used; the points where streams become navigable is indicated; also where the ground is soft, mossy, bog, morass, or swamp.[1] On the maps of some countries, *e.g.* that of France on a scale of 1 : 100,000, the actual number of inhabitants is placed under the name of every town and village of over a certain population; and it is shown whether roads

[1] *Notes on the Government Surveys of the Principal Countries of the World.* Intelligence Division, War Office, 1882.

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are fit for carriages all the year round or only at certain seasons. The Russians have no less than 210 signs and 170 abbreviations on their staff maps.[1] On the staff maps of Austria 195 signs are in use, while on the "mother map" of France there are only 41 conventional signs, but these are supplemented by 131 abbreviations.[2]

It will be seen from this that such a map, intelligently read, will give not only the features, natural and artificial, of any district, but also the occupation or trade in which the majority of the population are engaged. An estimate may be formed of the supplies that can be drawn from a given area; a rough idea of the water-supply and of the number of inhabitants can be obtained. The map will also show the buildings that may, if necessary, be strengthened, or which may serve as depôts or hospitals, and the shape of villages and woods which may serve as military positions. Camping-grounds may be selected where drill and manœuvre-grounds exist. Facilities for shoeing and repairing will be found at the forges. In fact, if we ask the map a question on almost any subject of importance in relation to military operations, a reply will be forthcoming if diligently sought.

On this question of the maps hangs the whole subject of military geography, but it requires no little study, no little perseverance, to become a really quick and competent map-reader. But, by constant practice, the maps will be found to unfold the complicated pages of history and unravel the tangle of military operations which so frequently hangs around selected military positions. For instance, Ulm was the scene of operations by the French armies which undertook the invasion of Austria in 1703 under Villars, and also in 1796 and 1800, and again in 1805 under Moreau. And why? This is a very simple question, and the map gives a correspondingly simple answer. The valley of the Danube from its source to Ulm is one continuous defile, which is closed by the fortress at that place; and, moreover, the Danube from Ulm to Ratisbon clearly appears to be the key to the whole of South Germany.

Again, so far back as Hannibal's time, the Romans endeavoured to cover the entrance to the Stradella Pass. Here, too, the troops of the German empire defeated the French and Spaniards in 1746. In the same neighbourhood Macdonald fought for three days with the Russians in 1799. Napoleon III. also appeared in the same locality in 1859. These are matters of history, but when we come to the question why these things were so, we must go to geography for the answer, and, as before, the maps give a ready reply, namely, that the Stradella Pass is a defile and covers the line of the Trebbia, which together with the courses of the Ticino and Po forms a water-line that may be characterised as the first great military obstacle beyond the Alps which must be encountered by an army invading Italy. In fact, the maps reveal the secrets of all past military operations and form the groundwork of all that have to be taken in hand. Had there been a topographical survey

[1] *Signaturen-Schlüssel zu allen Karten des russischen Haupt-Stabes.* Cremat. Leipzig, 1894.

[2] *Guide Pratique pour la lecture et le mode d'emploi de la Carte de l'État-Major par le Capitaine E. Espérandieu* 2e édition. Paris.

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of the United States at the time of the war between the Federals and Confederates, and had it been read with discernment, it is safe to say that it would have taken the leaders as many hours as it actually took months to discover that the Mississippi was an objective of primary importance, and, though far from the centre of the southern Confederacy, was, in point of fact, the governing element in the strategic position.

In forming any plan of operations, then, when the area has been sufficiently studied on the large topographical maps, the strategist will take the special railway maps, and these, in conjunction with the dislocation maps, as they are called on the Continent, which give the disposition of the troops, will show the means at hand for bringing the forces up to any required front.

Captain G. M. Wheeler of the Corps of Engineers, United States Army, commenting on the great topographical surveys, tells us that it is found that there has been used, throughout the maps of European countries, either by names or abbreviations or conventional signs, a distinction between 1148 delineated objects, natural and artificial, and then he continues:—

"All of these, without exception, upon scales (large and small) dependent upon either a study of actual theatres of war, or approaches thereto, or intercommunication, are a true requirement of the strategist and commander, and thus very properly through the centuries topography has grown up a permanent unvarying essential of the military profession, than whom none other is ever to have the same need for the knowledge thus recorded, while unremitting vigilance is necessary to its protection from spoliation at the hand of such filibusters, as may, under the flag of the sister sciences, march forth to the subjugation of this, in common with all other scientific knowledge, in order that it may be finally prostituted to their sole ambitious aims.

"As an aid in strategical movements, the forward manœuvres of the Prussians during their entrance into France, and in their methodical march on Paris, was an apt illustration of the precision and despatch (counting to the hour) with which large bodies of troops may be disposed and handled over a terrain, known in advance in minute detail and faithfully shown upon the map. Much of this very detail (of later or current date) had been secured by German topographers prior to the commencement of hostilities, and it may safely be asserted that the Germans were to some extent able to organise their aggressive movements with more certainty of success because of their intimate knowledge of French territory, and since all this information had been placed graphically in the possession of field and other officers, and in the hands of non-commissioned officers even, in forms suited to all requirements."[1]

To turn now to countries which have not been properly surveyed. Lord Napier's Abyssinian expedition was undertaken at a time when little or nothing was known of the country; the Ashanti expedition of 1873 was carried out under similar circumstances; so, too, were many campaigns in the North-west Frontier of India and in Burma. These facts would appear to contradict the maxim as to the foreknowledge of

[1] *Report upon the Third International Geographical Congress and Exhibition at Venice*, 1881. Captain G. M. Wheeler. Washington, 1885. Page 85.

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the country which is essential to success. But it is only the matter of time which causes this apparent discrepancy, for the knowledge was obtained on the spot and all these undertakings were based on reconnaissance. General Chapman tells us

"That during the campaigns and expeditions undertaken by British troops since the Crimean war, they have been called upon to work in countries which were not fully mapped previous to the commencement of military operations, countries regarding which the information available was comparatively scanty, and the physical conditions of which offered unknown difficulties. In all the varying movements which have been undertaken our troops have entered upon ground but little known, and the study of the physical geography of the different areas in which movement was prosecuted has devolved upon the commanders and their staff during the actual conduct of operations. The Intelligence Department of the War Office and the Intelligence Branch of the Quartermaster-General's Department in India are organisations of comparatively recent date. They have done and are doing work which tends steadily to reduce our ignorance in fields more or less remote, where we may at any time be called upon to act. So long, however, as Great Britain maintains control over a vast empire in both hemispheres, we shall have to face the necessity of entering on theatres of war regarding which geographers and cartographers can tell us little."

It is necessary, therefore, that there should be with an army reconnoitrers capable of running a rough triangulation and of sketching in the country by plane-table and traverse; and the more such reconnoitrers there are the better. India is our great school for military surveyors, and of the many good men turned out from there, one of the best has suggested a scheme whereby similar work might be carried out in this country, by way of practice, though the terrain lends itself but little to such work.[1] This, it will be readily understood, is a most important branch of military geography, and, for an army in the field, almost the most important. How the mapping is carried on, and how the troops are supplied, is told by Col. J. C. Dalton, D.A.A.G., who was at the head of the topographical section of the Intelligence Division of the War Office in 1890, when he took part in the discussion on General Chapman's lecture to which I have alluded above.

"When an expedition is to be despatched from this country on active service, the Intelligence Department has first of all to take into account whether it is a country of which there are already perfect surveys, like our own, or whether it is to a country of which only imperfect surveys or rough maps and sketches exist, such as those we may have made ourselves or may get from travellers and explorers. In the first case we already possess the survey maps of the country, and it would be our duty to get them reproduced as rapidly as possible and issue them freely to the army. That is an easy mechanical operation. But in the second case, say for an expedition going into Central Africa, which is very little known, the circumstances are quite different. In the Intelligence Department are kept maps of every part of the world in which we take an interest, and to which we

[1] *Suggestions as to the best Method of teaching Small-Scale Topography* and *A Description of the Method of executing Rapid or Reconnaissance Triangulation.* By Major Hon. M. G. Talbot, R.E.

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might have to send troops. We compile maps of these countries which we keep up to date, and to this end we have the cordial assistance of the Foreign and Colonial Offices and of travellers, explorers, etc. Therefore by the time the expedition is ready to start we are able to supply it with a quantity of maps; and with these they must work at starting. The maps are as good as we can make them; they are not surveys, but are compilations from the best authorities. With every expedition there will be a Field Intelligence Department, the duties of which are laid down in a manual specially prepared, and which will be issued to all concerned at the proper time. It is important, however, to note that the officers attached to the Field Intelligence Department will have nothing to do with making maps in the field; their work is entirely with regard to the enemy. There will, of course, be a number of officers with the force who are specially selected for their aptitude for topographical and reconnaissance work, and they will be told off for field sketching, etc., for the expedition when it arrives at the theatre of operations. These officers will be under the Chief of the Staff, and all sketches done by them will be at once handed over to the Field Intelligence Division, who will have them reproduced on the spot by the Royal Engineers, who are provided with complete photographic and lithographic apparatus. The Field Intelligence Division will be responsible for the issue of these to the troops, and will at once despatch copies of all the sketches to the Intelligence Division in London, whose duty it will be to revise their maps with this new work and keep the expeditionary force supplied with the maps as revised. . . . As regards the actual surveys of the country, that is a much more difficult and expensive affair, and requires specially instructed surveyors. The principle may be generally accepted that no trigonometrical survey will be attempted in the immediate theatre of active operations,[1] but that as a country is occupied this work will be undertaken by sections furnished by Royal Engineers, who are thoroughly trained in Ordnance Survey work. . . . During the Sudan campaign of 1884-85 the Intelligence Department in fifteen months prepared 44 maps and issued 13,000 to the troops for military purposes."

Similar arrangements to the above have been made at the front for the reproduction locally of maps and sketches made by officers on the spot during the present war, and no less than 100,000 sheets of maps have already been sent out to South Africa, including maps and plans of localities of military importance, as well as large numbers of one-inch and four-inch maps of the north of Natal, and of the Orange Free State and Transvaal respectively.

Dr. Maguire divides his book into fourteen chapters. The first deals with the importance of the study of military geography; the second is entitled "The Leading Principle of Strategy and Military Geography"; and the third, "Other Strategical Considerations." The last two have been summarised in the paragraphs on strategy. Then follow four chapters devoted to the "Command of the Sea," the "Strategic Importance of the Mediterranean Sea," "The United Kingdom with regard to Sea Power," and the "Strategic Relations of Europe with other Continents." The benefits to be derived from the command of the sea have

[1] It has, however, been found possible, as mentioned by Major Talbot, to do this on several occasions, though of course not with the same accuracy as would be the case with a regular topographical survey.

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been lately insisted on in learned works, in the press, and elsewhere, almost *ad nauseam*. That our command of the sea has alone permitted us to land our forces, without hitch, in South Africa is a matter which is patent to all. That we have the necessary strong halting-places, and *points d'appui* on the road to India is matter for sincere congratulation. The existence of our four fortresses, Gibraltar, Malta, Halifax, and Bermuda is of great military importance. But the subject of these four chapters would be better dealt with in a work on naval geography or on strategy. The first of the four chapters traces the command of the sea from the earliest times, and gives a classified list of our ships of war, and suggestions as to their employment, and list of coaling-stations. The next contains an interesting history of Malta, and explains the advantages of Gibraltar, and the importance of Byzantium, and Constantinople, and the like. In the third are traced our exploits on the sea from the time of Richard I. to the present, and a summary is given of the increase in the area of the Empire, and of the revenue and expenditure; while the fourth deals with the importance of Hawaii and Cuba, and a hypothetical invasion of Europe by the New World. Chapter VIII. is devoted to frontiers. "No mountain frontiers," it is stated, "have prevented invasion, or for long stopped the tide of war, but they are of great strategic utility, as, much more than rivers, they limit the avenues by which the invader can advance to his object," and this is supported by historical proof. The boundaries of Austria are then considered, and then follows a digression on mountain warfare in Switzerland. Some frontiers are mere arbitrary lines, as in the case of Canada and the United States, a fact which is also alluded to later on, when the Canadian Pacific Railway is dealt with as a means of communication. Examples are given of the effect of the geometrical form of frontiers, apart from their physical constituents. Frontiers may be zig-zag, or they may be re-entering, as against an enemy whose base is far away, or, again, re-entering as against an enemy who is within the angle. Russia, for instance, is very close to Berlin, but it is a far cry from Germany to St. Petersburg or Moscow. The mutual frontier relation of Prussia, Austria, and Russia are then well described as follows:—"Leaving out any considerations of mountains and rivers, it will be obvious that Austria-Hungary projects eastward between Roumania and Russian Poland, and therefore threatens the right flank of every Russian movement, from Pruth towards Buda-Pesth, through Roumania, or Servia, or over the Danube into Bulgaria. Russia felt this severely in 1854. Again, east Prussia threatens the right flank of any Russian movement through Poland towards Berlin. Further, let us suppose that Austria-Hungary and Germany were allied against the Russian, the latter, when moving against either foe, would be flanked, and in great danger from both; accordingly every possible strategic precaution is taken by all three Powers, and there are great works and places of arms at Königsberg, Dantzic, Thorn, and Posen in Prussia; Brest-Litovski, Warsaw, Novogeorgovitch, and Ivangorod in Poland; and Cracow and Przemysl in Galicia." This chapter closes with a description of the frontiers of Switzerland, the Franco-German boundary, and an allusion to the folly of the great wall of China.

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The vexed question of fortresses is dealt with in the following chapter. The great authorities are at loggerheads as to the value of these vast structures. Pierron goes the length of thinking that most of them are useless, if not positively dangerous. That no fortress has ever given permanent security to a state goes without saying. But as all nations build these structures, their belief in them is evidently not shaken; and when properly placed at great strategic points they are doubtless of the first importance. But it is the bad positions chosen, and the multiplying of fortresses which tends to discredit them. The French fortresses would altogether shut up no fewer than 600,000 men, who ought to be in the field; and it is matter for speculation whether Paris would have fallen so easy a prey had the Metz garrison been at large, and been joined by the forces which Gambetta was raising; for they could easily have threatened the German lines of communications. But whatever be the opinions of the experts with regard to fortresses, there can be but one with regard to fortified camps or entrenched positions, when considered in conjunction with the range, precision, and rapidity of fire of modern weapons. The present campaign gives ample proof, if proof were needed, after the experiences of Plevna, of the value of such hastily prepared works, when the terrain lends itself to their suitable construction. The case for fortresses may be put briefly thus: if a fortress be on an enemy's line of advance, he must either take it or work round it. In the first case he may waste a great deal of time, or have to leave a detaining force, and so weaken his army; in the second, his line of communications is liable to be constantly harassed and threatened. "Admirable sites for fortresses are either hills commanding bridges over which invading armies must pass, or bridges themselves, when no hill is in the neighbourhood. When a river is parallel to the line of advance of an enemy, fortresses protecting the main bridges are most serious obstacles. When several rivers converge, and other circumstances are favourable, their points of convergence are admirable sites for a fortress."

The next four chapters Dr. Maguire devotes to the consideration of a matter of the greatest consequence in military geography, namely, Communications. To historic lines of invasion two chapters are allotted, and one each to "The Principal Routes of Invasion and Main Lines of Communication," and "European Defiles and Roads." With regard to the historic lines of invasion, Dr. Maguire deals with the subject of Alexander's Eastern expedition, and gives a summary of the route, and in the same manner he treats Hannibal's march from Spain to southern Italy. He then alludes to the fine strategic movement of Nero against Hasdrubal, the invasion of the Cimbri, Cæsar's campaigns in Gaul, and the successive invasions of the Alans, Huns, Goths, Lombards, Vandals, Burgundians, Franks, Anglo-Saxons, Saracens, Magyars, and Osmanlis, with dates and historical notes, but very little geography; and then Dr. Maguire, after having (on page 168) insisted with due solemnity on the necessity of the greatest forethought, of the minutest knowledge of the whole anatomy of the mountains, the geographical distance of the several valleys and passes from each other, their facilities of lateral communication, their exact bearings and windings, as well as the details of

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their natural features and resources, and so forth, gives both himself and his subject away (on page 300), declaring that "no profound knowledge, even of geographical details, is necessary for successful invasion; that the main lines of road, railways, and strategic marches are always the same." True, it takes very little knowledge of geography to follow a historical account of a march, but a good deal to see the reasons; and still more for the successful planning of an invasion. This part of the subject closes with an account of Alaric, Attila, Jenghiz Khan, Timurlane, and Bonaparte.

In the chapter entitled "The Principal Routes of Invasion and Main Lines of Communication," after noticing that there are 232 passages on the Franco-Italian frontier, which render the turning of Alessandria by a French force comparatively easy, Dr. Maguire deals with our Indian frontier, and the two possible lines of advance of Russia on India, the Pamirs being excluded as utterly impracticable. And by way of introduction, he tells us of the penetration by Alexander, the Moghuls, Timurlane, Mahmud of Ghanzi, Mahomed Ghuri, Jenghiz Khan, Baber, and Nadir Shah, and then treats of the tribal warfare of late years. Dr. Maguire is always at his best in historical allusion, which, indeed, forms the chief part of his book. He is quite at home in the historical part of the subject—which, of course, is an important part—but not the principal part. The principal part is geography, pure and simple, as detailed in the maps. It is well to know, for instance, that Napoleon followed in the track of Hannibal. It is not only interesting but important. But what we want to know is not so much that they both took the same route, but why they took that route at all. And the maps tell us. But to proceed. The two lines of advance on India are set down as, first, a north-western line from Samarkand or Bokhara to the north of the Oxus near Balkh, by the valley of the Oxus to Bamian and on to Kabul. This route would give the Russians some 700 miles of difficult and desert country to traverse. The second is a south-western line from Baku across the Caspian to Michailovsk, and thence to Merv, Herat, and Kandahar, with only 370 miles of such country as mentioned above.[1] Then follows a digression on the preparations for the construction of the Burma railway, the cost of labour, the difficulties attending the survey and construction of the line, and so forth, followed by a short account of explorations by Lieutenant Walls-Jones and Captain Wingate between Burma and western China. The Canadian-Pacific, Cape-Cairo, Uganda, and Trans-Siberian railways are then noticed, and of the first-named a fairly detailed geographical description is given, sufficient at least to show its importance from a military point of view. The others are wedged in between the sudd in the Bahr-el-Ghazal, the civilising effects of railways, the man-eating lions of Uganda, and the unsuitability of camels for daily movement, and the chapter concludes with a warning note as to the possible use, by France and Russia, of Abyssinia as a weapon against British prestige and British commerce, both in Africa and Asia.

Of European roads and defiles, the following are mentioned :—

[1] This subject is treated at length in a recent Russian work entitled, *Towards India: a Military, Statistical, and Strategical Study—Russian Plan of Campaign*. By M. Lebedev; which has been translated into French by Captain Cazalas.

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EUROPEAN DEFILES AND ROADS.

EAST EUROPE:
1. From Siberia by route of Siberian Ry., *viâ* Ekaterinborg in East Russia to Samara and Moscow.
2. By Orenberg.
3. *viâ* Derbend, Georgia, and Dariel pass (Caucasus) into South Russia.

BALKANS:
Slivno or Selina, Shipka, Trojan, Etropol passes, and between Orkanie and Sophia.

HUNGARY:
Rothenthurm pass, south of Hermannstadt; Thömöser pass, south of Kronstadt; Vereczke route; and Bogrod and Vistula valleys.

MORAVIA:
Trouée of Oder river.

BOHEMIA:
Nachod, Trautenau, Reichenberg, Pirna, and Toplitz passes.

AUSTRIA—ITALY:
Semmering pass to Villach, and by Tarvis pass to Udine—Bruck—Larbach—Trieste or Fiume.

AUSTRIA—SWITZERLAND:
Vienna — Kufstein — Innsbruck — Arlborg pass.

ITALY—CENTRAL EUROPE:
Venice—Innsbruck by Bremmer pass; Stelvio pass.

SWITZERLAND—ITALY—GERMANY:
Splügen pass; St. Gothard, and thence to Alldorf — Zurich — Schaffhausen—the Black Forest roads.

SWITZERLAND—ITALY:
Simplon, Grimsel, Gemmi, Bernardine, Septimer and Bernina passes; Great St. Bernard.

AUSTRIA:
Pusterthal and Maloja defiles.

SWITZERLAND:
Furka and St. Maurice.

FRANCE—ITALY:
Little St. Bernard, Mont Cenis, Genèvre, Tenda, La Corniche.

FRANCE—SWITZERLAND:
Across Jura mountains at Pontarlier, and at Porrentruy; Gap of Burgundy.

FRANCE—GERMANY:
Roads from Mülhausen, Colmar, Schlettstadt; Schirmeck pass—Strasburg to Epinal; Saverne gap—Strasburg and Paris; Maubeuge — Namur — Liége — Cologne; Düsseldorf; many roads in north part of Black Forest; Hollenthal defile in south; Wutach river—Lake Constance; the Rennstiege of the Thuringian Forest.

FRANCE—GERMANY—RUSSIA:
Roads through all the big Rhine towns from Strasburg to Arnheim connecting valleys of Moselle, Meuse and Seine with Leipzig, Berlin, Warsaw and Königsberg, and with St. Petersburg, Wilna, Moscow, and Kiev.

FRANCE—SPAIN—PORTUGAL:
On west, Bayonne—San Sebastian—Burgos—Valladolid, and thence to Madrid or Lisbon.
On east, Perpignan—Barcelona, Valencia—Carthagena;
also 1. Lerida by Seo d'Urgel;
2. Zaragoza by Jaca and Urdos into France;
3. Roncesvalles pass.

SPAIN—PORTUGAL:
On north, Lisbon — Almeida and thence Madrid, or Burgos *viâ* Valladolid.
On south, Lisbon, over Tagus to Badajos, and south-east into Andalusia, and north-east to Madrid.

GREECE:
Salonika—Elassona—Larissa—Velestino — Pharsalia — Domoko — Lamia; Janina—Arta—Lepanto.

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In some cases historical illustration is given of when the road or defile was used for military purposes; in others the names are merely stated; but there is no geographical description of any of them, though Dr. Maguire certainly has the knack of giving life to the dry bones of a schedule.

Now in old countries the railways generally follow the roads, and these latter will be found on the plains and in the valleys. In new countries, such as the United States, the railways come first. And we shall find that any good railway map of Europe will give a very good idea of the general lines of advance. There is a little map attached to the Continental Bradshaw on which the principal lines are distinguished from those of secondary importance by being thickened up; and this map brings out most clearly, and with sufficient accuracy for a general summary, all the chief routes by which armies would move and have moved in the past.

The subject of the last chapter in Dr. Maguire's book is the "Influence of Climate on Military Operations." The races of the plains are contrasted and compared with those dwelling in mountainous regions, and countries in various latitudes are considered in this connection—India, China, Germany, and various parts of equatorial Africa. The severity of the seasons is noticed in relation with Napoleon's Russian expedition, the Peninsular war, and Plevna and the Shipka Pass, and there are concluding remarks on disease among troops.

The climatic conditions of the theatre of operations is of prime importance as affecting the health of the troops, their staying power and the supply of suitable clothing, as well as the water-supply, the fordability of rivers and the state of the roads; and therefore the meteorological section of physical geography should form one of the subjects which go to make up military geography. That portion of South Africa which at present forms the front of operations will be considered here by way of example. As regards the rainfall, the whole of the area, embracing the positions of our troops in the neighbourhood of the Modder river, Colesberg, Stormberg, and Ladysmith, falls within the region which derives the chief part of its water-supply from the summer rains brought up by the south-east trade winds. Over the whole of this area more than seventy per cent. of the total amount of recorded rain falls during the summer months, that is, from October to March.[1]

At Ladysmith the mean rainfall during each of the months May, June, July, and August is less than one inch; during September it is between 1 and 2 inches; during October the mean amount registered rises to between 3 and 4 inches, and during November and December to from 4 to 6 inches. During January the mean rainfall reaches its maximum, and is over 6 inches. In February it decreases slightly to from 4 to 6 inches, and there is a still further decrease during March to between 3 and 4 inches; and this decrease is continued in April, the fall then being between 2 and 3 inches. The following table shows the mean monthly rainfall for the other three localities:—

[1] *Report of Cape Meteorological Commission for* 1897.

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	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May.	Jun.-Sep.
Modder Riv	1″—2″	1″—2″	2″—3″	2″—3″	3″—4″	3″—4″	1″—2″	under 1″	under 1″
Colesberg....	1″—2″	1″—2″	1″—2″	2″—3″	2″—4″	3″—4″	1″—2″	under 1″	under 1″
Stormberg...	1″—2″	3″—4″	2″—4″	3″—4″	4″—6″	4″—6″	2″—3″	1″—2″	under 1″

Next as to the mean temperature; during September the isotherm of 70° Fahr. coming from the north just touches the three western districts, and bends up northward again through Ladysmith; during October this curve moves farther south, almost parallel to its September position, leaving all four districts warmer. In November the mean temperature of the western positions is still further increased, while the eastern district is almost touched by 80° curve. In December the isothermal curve of 80° touches all four positions, and the 90° curve approaches all of them in January, which is the warmest month. In February we find that the 90° isotherm recedes, and in March we are back again at the December mean temperature of 80°. In April the 80° curve recedes farther north, and in May all four districts lie under the 70° line. In June the position of the 70° curve is placed considerably farther to the north, and in July the western districts lie on the 60° curve, the eastern position (Ladysmith) being shown as somewhat warmer; and the conditions remain the same during August.[1] Here the temperatures are reduced to sea-level, and therefore an allowance must be made for altitude. A deduction of 1° Fahr. for every 360 feet will be quite near enough to the truth for the purpose in hand. The elevation of the country round Ladysmith is between 3000 and 4000 feet, and that in the neighbourhood of the Modder river is about the same; while both the Colesberg and Stormberg districts lie at a greater altitude than 4000 feet. The daily variation of temperature is also of great importance, and this during the summer months is considerable in the northern portion of the Cape Colony, and also in the inland districts of Natal.[2]

To return to Dr. Maguire's book, it is interesting throughout, and well put together, and had it been called An Introduction to the Study of Strategy there would have been little fault to find with it; but as a military geography it is sailing under false colours. Dr. Maguire would make geography the handmaid of history, whereas the geography is the foundation: to have logical sequence one must have the ground first, and the military operations on it afterwards.

[1] *Bartholomew's Physical Atlas*, vol. iii., Meteorology.

[2] A shade temperature of 107° Fahr. has lately been registered in the neighbourhood of Ladysmith.

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WESTERN AUSTRALIA IN 1899.

By the Hon. E. H. WITTENOOM, Agent-General for the Colony.

FOUNDED in 1829, and containing nearly 1,000,000 square miles, Western Australia ranks among the older Colonies of Australasia. Its settlement was slow, owing to various difficulties encountered in developing it—the hostility of the aboriginals, the density of the growth of the land, and, to some extent, the unsuitability of many of its early settlers. Still, these settlers had the old British pluck, and stuck to it with varying success, until, in 1890—as a Crown Colony governed from Downing Street, London, with a population of 46,000—they were producing from the land all they required, and more than they had internal markets for; their revenue and expenditure balanced, and the public debt was very small.

This was all accomplished without the artificial aid of precious metals or minerals, which were such potent factors in the phenomenal successes and advancement of the neighbouring Colonies of Victoria, New South Wales, etc. No doubt the discovery of gold in those Colonies in the fifties induced many people to go there instead of Western Australia, and so delayed its progress; moreover, its remoteness and inaccessibility at that time were strong influences working against it.

In 1890 responsible government was granted by the Imperial Government, and gold commenced to be found in all directions. Since that time the progress has been wonderful; as may be judged from the facts that the revenue in 1890 was about £400,000 and in 1898 was £2,600,000, the gold yield in 1890 about £86,000 and in 1898 £4,000,000, and the population 46,000 in 1890 and 168,000 in 1898.

CLIMATE.

The first subject I propose to deal with (and a by no means unimportant one, health being a primary consideration) is the climate. And in this connection, being a native of the soil, and having spent the greater part of my life there, I can speak with authority. I have no hesitation in declaring it very healthy, especially that portion of the Colony known as the South-western Division. This statement you will find unanimously endorsed by all those who have had any experience of the country. I have resided in or visited a very large area, and have hardly had a day's illness. During the fifteen years I spent in pastoral pursuits I had a great deal of exposure, often sleeping for nights together in the open bush without any protection, except some bushes or a tree to break the wind, and felt no ill effects. I do not pretend to say there is no illness; but wherever sanitary arrangements are attended to, and people live moderately and avoid excess, they may expect a long and healthy life. The northern portions are naturally hot, being in the tropics, and residents there require an annual change to cooler climates; in the interior, also, at distances a hundred miles or more from the sea, the thermometer in the summer reaches occasionally from 100 to 110 degrees,

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but the heat is not so oppressive or relaxing as I have found it in London at 90 degrees. Throughout the South-west Division the climate is quite agreeable. The season is divided into wet and dry, and the average rainfall varies from 18 inches about Geraldton to 40 inches in the vicinity of Albany. Perth, Freemantle, and its surroundings receive from 25 to 35 inches. Ice is occasionally seen in these parts in the depth of winter.

Land.

In the South-western Division most of the production of the Colony takes place. It comprises in round numbers some 60,000,000 acres. There is still plenty and to spare for all who wish to go there. They will be received with every encouragement, and the land laws, which are most liberal and encouraging, provide, amongst other things, that 160 acres of land shall be given to each person for nothing, the only condition being that he shall live on it and improve it a little each year; while if he desires to add to this quantity he can take up an additional 1000 acres, paying for it in twenty years at 6d. per acre per year. I wish it to be understood that the class of person most required at present is the agriculturist or horticulturist who understands his work, and has say £200, in which case the Government gives £10 towards his passage-money. The Government cannot see their way to adopt and assist general immigration, as they are not prepared just at present to introduce a class that would compete with the working population. What is required is the man who will develop the land and employ labour, thereby encouraging both production and consumption, and I know numbers of cases where farmers and gardeners have succeeded in securing not only a good living but considerable competence. The land is particularly suitable for farming and gardening, some spots being naturally more fertile than others. The inland districts of York, Northam, Toodyay, etc., are eminently adapted for the production of wheat, barley, oats, also vegetables and some fruits; whilst a large portion of the coast where the climate is milder and the rainfall heavier, is suitable for a variety of English fruits, dairying, etc. I do not know any place where a person fond of horticulture could so profitably indulge his taste in this Colony. In some of the valleys and nooks in the hills, the vine, fig, peach, apple, and all manner of vegetables thrive and flourish; and I have in my mind's eye at this moment many charming homesteads surrounded by lovely vineyards, gardens, and well-filled cellars, whilst flowers flourish with the greatest luxuriance. There is an immense future before vine-growing; most of the land on which the now far-famed Jarrah thrives is suitable for this purpose, while the demand for wine at present is so great, and the price so good, that few care to keep any sufficiently long to mature. The great want in wine-making is people who thoroughly understand the process in all its branches. To give some idea of the extent to which farming and vine and fruit growing are carried on I state that up to the end of 1897 there were under cultivation 162,000 acres of farm, 3000 acres of vines, and 3600 acres of fruit-trees. The latter comprise oranges, peaches, figs, apricots, plums, pears,

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lemons, quinces, nectarines, almonds, cherries, mulberries, olives and loquats.

Poultry thrives splendidly, and repays any one who understands the business. The consumption of produce on the gold-fields being far more than the production, prices to the producer are very good, and must continue so as our gold-fields increase. As some of the prices that produce realises may be of interest, I quote a few:—Fowls, 4s. 6d. to 7s. 6d. per pair; flour, £10 per ton; bacon, 10½d. per lb.; wheat, 4s. to 4s. 6d. per bushel; potatoes, £8 per ton; chaff, £4 per ton; eggs, 1s. per dozen; apples, 9d. per lb., and oranges, 6d. per dozen.

Gold-fields.

Having pointed out how the producer may get land, what climate and rainfall he may expect, and the class of articles he can grow, I now propose to devote attention to our gold-fields, which provide a large consumer for the producer, and have been the principal cause of our great success the last few years. Some people date our onward movement from the introduction of responsible government, others from the extended discovery of gold. Although I am sure that both have been great factors, I cannot help thinking that the balance is in favour of the gold.

The history of the discovery of gold in Western Australia is of consuming interest, the more so as such a number of years passed before anything of value was found. I have often in my younger days, when riding over miles of quartz plains, wondered why Western Australia should be the only Colony where gold did not exist, but at last it came. In 1885 it was discovered in the Kimberley district 400 miles inland. A party of six went prospecting, and just beyond the junction of the Panton and Elvire rivers found gold on August 30th. They collected ten ounces in five or six days. This news caused a phenomenal rush. People flocked from all parts, until in 1886 there were nearly 2000 people there. But the difficulties were very great in reaching the locality, and the alluvial gold not too plentiful. Hundreds turned back disappointed. Provisions went up to starvation prices, and the field was to a large extent abandoned. Nevertheless good gold is to be found there still, and numbers of reefs show prospects, whilst the few that are being worked give fair returns. Although the Kimberley field was not altogether a success as a gold producer, yet it had a great influence on the future of this industry, inasmuch as it was the means of introducing an experienced and energetic class of prospectors. The next discovery of importance was Yilgarn; Southern Cross is the centre of settlement in this part at the present time, and the railway from Perth to Coolgardie goes through it.

In 1888 the Mallina gold-field was discovered by a lad, who, picking up a stone to throw at a crow, observed a speck of gold in it. In this vicinity also, at Balla-balla, a fine lode of copper was reported on by the Government geologist. During this time four good nuggets were found in the Pilbarra district, weighing respectively 35½ ounces, 103 ounces,

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and 140 ounces. The gold export for 1888 was 3493 ounces, value £13,273. Various discoveries were made up to 1891, such as Berin on the Murchison in 1888, at the Ashburton in 1890, at Cue, Murchison, 1891. The first payable gold in the Murchison was found at Nannine by a small party of prospectors. They kept the discovery quiet as long as they could while they collected the alluvial, getting as much as 190 ounces in one day. I know young stockmen who have often driven their cattle and ridden over this ground, little dreaming what a fortune was close to their hand. Subsequently gold was found over a large area, nuggets varying from one ounce to forty being not at all uncommon.

It would seem, however, as if the really extensive finds of gold were awaiting the introduction of responsible government, because the discovery of the far-famed Coolgardie took place shortly after that event. It happened in May or June 1892. Two prospectors named Bayley and Ford secured a two months' supply of food from Southern Cross with two horses. After a long prospecting tour in this wild country, they, one morning before breakfast, picked up a nugget weighing half an ounce. At the time they were camped at a native well known as Coolgardie. Shortly after they picked up a seven-ounce nugget, and in a few weeks they gathered some 200 ounces. By this time their supplies were exhausted, and they had to go to Southern Cross to replenish. Without mentioning their discovery they returned to the spot, and after a time discovered a reef with gold showing very thickly. The quartz was full of nuggets, and during that day they secured 500 ounces knocked off the reef with a tomahawk. Their discovery shortly after became known, but not before they had secured some 2000 ounces. At the present time Coolgardie is a town of over ten thousand inhabitants. At a Mining and Industrial Exhibition recently held there, the finest specimens of auriferous ores ever collected were shown by the Mines Department and by the leading mining companies of the Colony. There was also a comprehensive and valuable display of agricultural products made by the Department of Agriculture, besides a large number of general exhibits.

In June 1893 Hannan's, now known as Kalgoorlie, was found. A few prospectors, among them a man named Hannan, camped at Mount Charlotte, and during a search for water in the rocks for their horses, one of the party found gold. They remained a week, discovered a deposit of gold, and in three days secured 100 ounces. This was the beginning of the richest gold-field in Western Australia, and at the present moment from 10,000 to 15,000 people are making a good living there, a large city exists, the streets of which are illuminated by the electric light, and it boasts one of the finest hotels in the southern hemisphere.

In June 1894 the Londonderry was discovered. It was purely accidental. Six men had been prospecting for months, and had been unfortunate. They had no money left, so they applied for work as miners on a claim for wages. They were unsuccessful, and decided on returning to Coolgardie. On their way they camped for the night in the bush, and some of the party occupied themselves in prospecting round about. Next morning a quartz specimen was found, and soon a

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magnificent reef was revealed, out of which in one day they dollied 1000 ounces, and in a few days had obtained nearly 5000 ounces.

The next sensational find was the Wealth of Nations. In July 1894 a prospector named Dunn sallied forth from Coolgardie, and after travelling about twenty-eight miles, came across a very large reef standing above the ground. After testing it he secured a specimen containing 800 ounces of gold worth £3000. Setting quietly to work he secured £12,000 worth of gold. Secretly he returned to Coolgardie with most of his gold hidden in the pack-saddle of his camel, placed it in the bank, applied for a lease, and hurried back as quietly as possible. But in some way the news got out, and over five hundred men left Coolgardie after him. There was some difficulty in restraining them from rushing, but no actual disturbance occurred. This property was eventually sold for £147,000.

The foregoing are some of the richest discoveries, but many others of lesser magnitude were continually taking place. New localities were opened up, such as Dundas, Lawlers, Mount Margaret, and others, so you will readily see that the gold is scattered over an immense area, so great that it is impossible for more than a small portion to have been in any way closely examined. The promise of the future is therefore very great; there is no reason why discoveries as valuable as those which I have described should not be made at any time. I believe the prospects of the Colony are magnificent, even though nothing but its gold deposits should be taken into account; not a few mines are now paying dividends, and there are many other properties which will give good returns if reasonably managed and not over-capitalised.

A few figures will show the present prosperity of this industry. The output of gold in 1890 was only some 22,000 ounces valued at £86,000, but in 1898 it was 1,050,183 ounces valued at £3,990,679; for the nine months ending 30th September 1899, it amounted to 1,160,000 ounces valued at £4,400,000; and for that month of September alone it was 167,076 ounces, valued at £634,890, being more than 5000 ounces over the best previous monthly record.

I would also point out that a number of the mines are giving excellent returns. The dividends paid or declared by British owned companies during the two and a half years ending 30th June 1899, have been as follows:—

1897, ...	£475,150
1898, ...	770,829
1899 (six months), . .	987,774
Total, . .	£2,233,753

It must be remembered that as the development of these fields increases, it means more occupation for miners and others who in their turn increase the consumption of marketable articles, thus reflecting better prospects to all the farming, gardening and producing industries of the Colony as well as to manufacturers in England.

Space will not permit me to deal with our splendid timber, which covers some 20,000,000 acres. I will only state that it is getting so

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well and favourably known throughout the United Kingdom and the Continent, that it is difficult to supply the demand. Being impervious to white ants, teredo navalis, and rot, it is conspicuously suitable for railway sleepers, street paving, piles for jetties, wharves, etc.

Coal is another of the Colony's valuable assets. The estimated area of coal-bearing land at the Collie is some 233 square miles. The development of this is proceeding apace. Several tests by large steamers have taken place with satisfactory results, and the quality is proving so good that the Government have decided to use it on their railways in place of the imported coal, and I understand that nearly 1500 tons a week are being utilised from the recently opened mines. These are situated only thirty miles from a seaport, and are nearer to India than any others.

Other Products.

In addition to the foregoing resources, the Colony has rich deposits of lead, copper, and tin. Pearls and pearl shells are produced on the north-west coast. On the immense pasture lands of the Colony there are no fewer than two and a quarter millions of sheep, producing wool of a good saleable type and class; 240,000 cattle, besides pigs and camels.

Imports and Exports.

Some details as to the imports and exports of the Colony may be of interest. I will therefore deal with the year ending December 1898. The total amount of all imports for that period was £5,241,965, that of the exports was £4,960,006. The fact of the imports being larger than the exports would, without explanation, appear unsatisfactory. In the first place it must be remembered that in 1890 the Colony produced all it required in food-stuffs, and at that time there was no expectation of a very rapid increase of population, so that when 100,000 people, mostly adults, rushed in between 1895 and 1897, the producers were unprepared for the demand which arose; and further, the brilliant gold discoveries drew many people from the farms to the gold-fields. In consequence, a very large proportion of the food supplies had to be imported from the neighbouring Colonies, and it is only during the last few years that Colonists have realised that there is almost as much profit in producing food-stuffs as in gold. In this way everything that is grown is consumed, and there is nothing for export except gold, timber, and wool. On the other hand, for the year referred to, £1,120,381 worth of supplies were imported, consisting of agricultural, dairy, and domestic produce, £878,701; sheep, cattle, and pigs, £241,680. Considering the quantity of good land the Colony possesses, its excellent rainfall and its liberal land laws, immigrants who take up agricultural pursuits have before them a fine prospect in reducing this large import, all of which can be produced from the soil. I may here explain that the policy of the Government is to encourage production by protecting the articles referred to by customs duty, while allowing the free importation of most goods that cannot be produced in the Colony. In the figures of the imports and exports, gold and bullion

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are of course included. The average rate per head of the population was £31, 3s. 6¾d. for imports, and £29, 10s. 0¼d. for exports. The total imports from the United Kingdom were £2,051,872, and from the Australasian Colonies £2,743,761. The latter are chiefly composed of food supplies and perishable goods, cloth or spun goods, apparel and drapery. The Colony has few manufactures. Although the exports for some time to come cannot be enlarged by food products, yet the increase

New Harbour, Freemantle, Western Australia.

in quantities sent away of gold, pearls, pearl shell, sandal-wood, skins, hides, timber, and wool, will make a large difference to the total. With reference to the shipping trade of the Colony for the year 1898, fifty-four sailing vessels of a tonnage of 45,140, and five hundred and six steamers of a tonnage of 1,104,360, entered the ports of the Colony with cargoes. Of these, thirty-seven sailing vessels and four hundred and forty-one steamers were British. The Messageries Maritimes steamers call at

S.W. Railway Bridge, Swan river, Western Australia.

King George's Sound, landing passengers and goods for the Colonies, and no doubt in time they will find their way to the chief port of Freemantle, which at present is entirely monopolised by the North German Lloyd, whose steamers are the only mail-boats that call there. In consequence, they are securing a very large proportion of the trade.

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Colony's Indebtedness.

The present liability of the Colony in the way of loans is, in round numbers, some ten millions, including amounts raised by treasury bills. This sum bears various rates of interest averaging 3½ per cent., which now amount, in the aggregate, to £350,000 per annum. As it may be interesting to learn how this money has been expended, I will give a few details:—

Railways and tramways,	£5,931,372
Harbours and river improvements,	1,020,890
Telegraph lines,	307,328
Public buildings,	138,173
Stock routes and water conservation,	486,955
Roads and bridges,	131,466
Water supply and sewerage for towns,	57,142
Miscellaneous (including boring for coal),	210,424
Land and other concessions acquired in connection with Great Southern Road,	300,000
	£8,583,750

This statement is made up to 30th June 1898, and as there was a certain amount in hand for expenditure after 30th June, this accounts for the balance between the total of the above particulars and the amount of the loans.

With regard to the railways and tramways, there were, on June 30th last, 1355 miles of Government railways open. These, with 430 miles of private lines, bring the total mileage of the Colony to some 1785 miles, or 105 for each 10,000 of the population, which is a very good proportion. The average cost of railway construction and equipment so far has been £5088 per mile, which is the lowest of all Australian Colonies, Queensland coming next with £7068, while New South Wales is highest with some £14,000; but the last mentioned is for a wide-gauge railway against the others at a gauge of 3 feet 6 inches.

The earnings of the Western Australian railways for the year ended 30th June 1899 were so satisfactory that after paying all working expenses and interest on the capital amount of £6,427,370, a sum of £70,862 was left to the good, so that there was only required the sum of £54,180, from other sources, in order to pay the annual interest on the total loan of ten millions. When the lines under construction get into working order, this result will no doubt be improved, and as time goes on and facilities increase the working expenses will decrease.

No doubt many may think that £10,000,000 is a large debt for 170,000 people to incur, but I would point out that in a young Colony many works, which in older and richer countries are carried out by private enterprise, must be undertaken by the Government. In Western Australia, for instance, the Government erect and maintain all railways, telegraphs, telephones, and schools; provide all water-works and supplies to towns, and subsidise municipalities. In new Colonies, moreover,

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facilities such as railways, telegraphs, post-offices, etc., must precede population and form some inducement for them to go and settle on the land.

When, therefore, the assets to which I have already referred are placed against our indebtedness, the most superficial observer must see in what a strong position the Colony is.

The revenue for the year ending 30th June 1899 was no less than

Settler's homestead Western Australia.

£2,478,800, a large amount to be produced by a population of 170,000 people without feeling it oppressive.

Harbour works of great magnitude are being pushed forward at Freemantle, which is the chief port of the Colony, and at Bunbury. A steamer drawing 28 feet of water has been safely moored to the wharf in Freemantle harbour, and more recently a 10,000 ton steamer did the same with safety and expedition. It is intended to deepen it to 30 feet, so that it will accommodate the largest mail-steamers. Bunbury is the

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natural outlet of a large timber area and the Collie coal-fields. Geraldton, in the north, has an excellent natural harbour, and is the port for the Murchison gold-fields.

Railways, post-offices, telegraphs, schools, and miners' and mechanics' institutes abound throughout the Colony, and the telephone is at work in Perth, Freemantle, Coolgardie, Kalgoorlie, and Albany. The city of Perth is beautifully situated on the Swan River, which is a mile wide at that spot. The social life of the community is good and attractive, while amusements of all kinds abound—theatres, sports, boating, driving, cycling, etc.

My object in giving these details is twofold. In the first place, to show that Western Australia is a desirable place for residence, where an energetic, industrious emigrant can make not only a living but a comfortable competency; and secondly, that it is a safe Colony for the investment of capital by the British investor. I have endeavoured to show what excellent assets we have—assets that, although proved, are to a large extent undeveloped. The financial position must be considered satisfactory, for against these assets there is only a public debt of about ten millions—the lowest of any of the Colonies by about fifteen millions.

A country cannot but be good where a community of 170,000 people can produce a revenue of two and three-quarter millions sterling without feeling it oppressive. I have heard it argued that it is unsound policy to lend money where the population is so small. This argument will hardly bear inspection, because since it is certain that ample resources exist, money which is spent on the means of development, such as railways, harbour works, etc., will immediately and rapidly increase the population. Western Australia has absorbed all the floating population of the other Colonies, and so therefore naturally turns to Great Britain for some of her surplus people.

The present seems a favourable opportunity to point out the unfortunate results which may at any time follow a disregard of the emigration question. Had those people of Great Britain who have leisure and wealth devoted a portion of each to organising some machinery for forwarding our own people to South Africa the present trouble might never have arisen, or at all events would have been largely minimised in that Colony. I cannot, therefore, too strongly urge that we should lose no time in taking definite action for increasing the sparse population of our Colonies with people of our own race. It would result in mutual benefit, and even in a return for the money expended if the undertaking were carefully organised and conducted.

Lastly, Western Australia has the advantage of being one of the Colonies of the British Empire, and can claim a foremost place amongst those countries and Colonies where free institutions and liberty of the subject are leading characteristics. Its parliament is modelled on the lines of that of Great Britain; its government is conducted by men of character actuated by honesty, justice, and energy. It is comparatively easy to acquire a voice in the construction and administration of the laws of the land, and no important position is closed to the man who has the ambition and ability to fill it.

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M. PAUL TUTKOWSKI ON THE ORIGIN OF LOESS.

In two articles on "The Steppes and Tundras of Prehistoric Europe," which appeared in the pages of this *Magazine* some time ago,[1] our readers were presented with a geological sketch of that remarkable loam termed löss, which clothes so much of the low grounds of Middle Europe. It was shown that the accumulation in question is of Pleistocene age—being interstratified with the morainic and fluviatile deposits of the Glacial Period. The organic remains met with in the löss demonstrate that tundra- and steppe-conditions of climate formerly prevailed over wide regions—and not only so, but that these conditions were repeated again and again. At one stage we find a vast mer-de-glace covering all Northern Europe, and extending southwards to the base of the mountains of Middle Germany, while Arctic plants and animals clothe and people the adjacent low grounds. At another stage the great ice-sheet withdraws, and its morainic and alluvial accumulations are worked over by the winds—dry conditions supervene, and for long ages the flora and fauna characteristic of steppe-lands flourish over the low-lying tracts where Arctic or tundra forms had previously prevailed. With each sucessive advance and retreat of the great northern mer-de-glace these alternating tundra- and steppe-conditions were repeated. No doubt tundras and steppes were to some extent contemporaneous, just as is the case at the present day. Arctic animals and plants lived in the tract immediately south of the mer-de-glace, while steppe-conditions flourished still farther south. When the retreat of the ice began, the two zones likewise shifted northwards, and thus eventually steppe-lands encroached upon tundras, just as the Arctic plants and animals in their turn gradually spread northwards over the regions vacated by the ice.

Referring the reader to the articles mentioned above for some account of the evidence which has induced geologists to agree with Baron Richthofen that the European löss is a dust-deposit and indicative of steppe-conditions, we now wish to point out that hitherto the cause of those steppe-conditions has been somewhat of a mystery. A number of years ago Mr. Jamieson showed that the presence of an ice-sheet covering Northern and North-western Europe, occupying the basins of the Baltic and the North Sea and extending westwards into the Atlantic beyond the coasts of Ireland and the Outer Hebrides, would necessarily produce dry conditions of climate in Middle Europe. "Such a mass of ice lying along the north-western border of Europe would act as a powerful condenser upon the moist winds coming in from the Atlantic. Precipitation would therefore take place before the clouds could reach the heart of Germany, and the climate there would be of extreme dryness. France would not be so much affected; but in travelling from France eastward through Germany to Austria the dryness would steadily increase." The general distribution of the löss, according to the same geologist, is quite

[1] June and July 1898.

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in accordance with his views as to the cause of the dry conditions, for the löss seems to augment in volume eastward from the coast of France. "It thickens in the valley of the Rhine, and is largely developed in the basin of the Danube, while over Southern Russia it extends in a continuous mantle."

But although we may well admit that during the existence of a great ice-sheet in Northern and North-western Europe any wind-currents coming from the Atlantic would be largely depleted of their moisture before they reached Central Europe, it does not follow that these winds were the cause of the löss. It is not at all likely that during glacial times the prevalent winds in Middle Europe were westerly, as they are now. On the contrary, as Dr. Croll long ago contended, the prevalent winds would be northerly and north-easterly; and he thought they would be exceedingly powerful, in consequence of the great difference of temperature that must then have existed between the equator and the higher latitudes. Quite recently the whole question as to the origin of the löss has been discussed in a most suggestive and interesting manner by M. Paul Tutkowski of Kief, who has been so good as to furnish us with an abstract of his views. We give a somewhat close translation, but here and there have modified his expressions so as to render his explanations more readily understood by readers who are not geological.

"I am of opinion," M. Tutkowski writes, "that the origin of the löss should be readily explained in Southern Russia, if anywhere. In that region it attains an enormous development, extending from 55° 55′ N. lat. to the Black Sea and its islands, and reaching even as far south as the Caucasus. It is in the central area—in those tracts, namely, where the löss attains its greatest development—that we may expect to meet with the normal type of the accumulation. In Southern Russia, therefore, the löss tells its own story very clearly. But when we come to examine the deposit along its northern borders, it presents an abnormal or local facies. In those marginal areas the formation of the löss has taken place under complicated conditions—not only under the influence of the principal, fundamental agent, but under the influence of divers secondary agents also. I maintain that it is the Russian löss, occupying as it does so broad an area in Europe, which is the normal or typical löss, identical with the löss of China and North America. The löss and *limons* of the French plateaus and Belgium, on the other hand, partake more of the abnormal facies, or "Rand-facies" of German geologists.

"After a careful examination of the several hypotheses which have been advanced in explanation of the origin of Löss, I have come to the conclusion that Baron Richthofen's æolian hypothesis is entirely consistent with the petrographical, stratigraphical, and palæontological evidence, and with the geographical distribution and the geological age of the normal löss of Europe and North America. There are many questions, however, which seem at first to throw doubt on the applicability of that beautiful hypothesis. Why, for example, is the formation of the great mass of the löss, alike in Europe and North America, connected with the Glacial Period? Why does no löss occur amongst pre-glacial

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deposits? Why does löss appear only in association with inter-glacial and post-glacial deposits—that is to say, why is it so intimately connected with the retreat of the great ice-sheets? How are we to reconcile a continental climate, so essential to the æolian formation of löss, with the supposed augmented humidity during the melting of the ice? Whence came the wind to produce the löss, and how could dry deserts exist in Europe during the retreat of the ice-sheet and glaciers? Why did the formation of löss come to an end with the close of the Glacial Period? Lastly, why does not löss occur north of a certain limit? To all these questions I have found a suitable reply; my solution of the difficulties is at once scientific, simple, and natural.

"By a theoretical analysis of the meteorological conditions of the great ice-sheet of Pleistocene times, I demonstrate that the isobars over the 'inland ice' were concentric, and that the gradients were centrifugal, whence resulted an enormous anticyclonic system which induced constant centrifugal winds. These winds would die off in the adjacent regions, but far beyond the southern limits of the ice-sheet. They would thus necessarily partake of the character of föhns, they would have a temperature elevated in proportion to the descent from the high central part of the inland ice towards its much lower periphery, and they would be very dry winds by reason of that dynamical heating. These conditions, it may be remarked, are to some extent realised at present in Arctic and Antarctic regions, being most pronounced where glaciation is most extensive, as in the north of Greenland.

"The geological action of the föhns of the Pleistocene inland ice could not come into play during the advance of the ice or while the glacier was in a stationary condition; and for these reasons:—(1) because the regions bordering the mer-de-glace were largely under water, the inundations being caused by the filling-up of the river valleys with ice; and (2) because the old soils beyond the inundated region were protected by a compact covering of vegetation, composed of an impoverished flora, somewhat Arctic in character. The inland ice, therefore, was margined by a zone of inundated pre-glacial sands, while farther away the plains were clothed with vegetation. In the west of Europe (as in Germany, for example) the glacier basins were more extensive, because of the want of an escape for their waters, dammed back as these were by the mountains in the south. In the east of Europe, however—just as in eastern North America—great river-valleys (Volga, Don, Dnieper, Mississippi) permitted the escape of the waters.

"The conditions that obtained during each definite retreat of the inland ice were very different. In Eastern Europe the waters of ablation or fusion, which owing to several causes must have been very slowly discharged, found a ready escape to the south by the old pre-glacial valleys of such rivers as the Dnieper, the Don, and others. These valleys as they were vacated by the ice showed no great thickness of glacial deposits. The rivers as they flowed on their way now deepened their beds, while the new rivers recently formed drained the glacier basins which were in this way considerably reduced. As the inland ice

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continued to retire it left deserts behind it—broad regions overspread with boulder-clay and pre-glacial sands. For a long time these regions must have been bare deserts, destitute of vegetation, owing (*a*) to the absence of a fertile soil, and (*b*) to the desiccating action of the glacial föhn. Subject to the effects of insolation, to chemical and physical decomposition and disintegration, and to deflation or the mechanical action of the wind, the region in question could not have been otherwise than a barren desert: I therefore term it the *zone of deflation*. The glacial föhn constantly scouring that zone swept up the fine powder or dust of the desiccated morainic accumulations and transported it far away to south, south-east, and south-west, finally depositing it over a broad region bordering the zone of deflation. That region of dust accumulation I term the *zone of inflation*. Meteorological considerations and palæontological evidence demonstrate that this last-named zone must have been a vast region of continental steppes (because of the dry föhn), clothed with vegetation and peopled by mammals of various kinds and by molluscs—most of the latter being terrestrial, although a few are lacustrine, thus testifying to the former existence of occasional lakes in the steppe-lands. It was in this region that the glacial föhn, owing to its diminishing gradient, gradually died out and deposited fine dust or the normal löss, charged with the remains of a steppe fauna and the relics of palæolithic man. Many geological and geographical facts support and confirm these conclusions. As the great mer-de-glace retreated, the zones of deflation and of insolation necessarily shifted northwards also. Hence in time the zone of deflation, characterised by its desiccated moraines and barren sands with wind-polished stones ('Kantengeschiebe') was gradually buried under löss. In short, as the zone of deflation moved northwards it was gradually encroached upon by the zone of inflation.

"All these phenomena necessarily recurred with each successive epoch of glaciation, and this is how I explain the appearance of inter-glacial and post-glacial löss. But the deflation of the morainic deposits could not be unlimited in space and time. When the margin of the retreating ice reached the northern regions of Europe and new seas (Baltic, etc.) began to appear, the climate of the zone of deflation would become more humid or less continental. Again, as the area occupied by the inland ice became more and more restricted, the föhns flowing out from it would become correspondingly feeble and inconstant, until eventually deflation and the æolian transport of dust would cease. It is for this reason that the range of the löss towards the north is strictly limited.

"Thus the normal löss, which with its abundant evidence of steppe-conditions overlies deposits that bear witness to desert conditions, is as truly a product of the old inland ice as are moraines, osar, erratics, striæ, etc. The difference between it and these is simply this, that the latter tell us of a time when the great mer-de-glace was in the heyday of its might and vigour, while the former are the witnesses of its decay and dissolution."

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CONCRETE GEOGRAPHY.

IT is remarkable that there has hitherto been no adequate and organised attempt to construct a synthetic geographical description of these Islands. The materials for such a work are voluminous and accessible. There are returns and reports of weather, of agriculture, of trade, of population; there are the maps of the Ordnance and Geological Surveys; there are records of the distribution of animals and plants; there is a large literature of the history of towns and counties. But these abstract records lose most of their meaning while they remain separate; they are sometimes unintelligible, often uninteresting. Their intimate associations, which alone can make them live, are not apparent, and indeed in large part have not been discovered. We need a general view of the geography of Britain which should in some degree represent the concrete and various relations of the Earth's crust, surface, atmosphere, organic species, and human society.

To Dr. Mill belongs the credit of having suggested, in 1896, a complete geographical description of the British Islands based on the one-inch maps of the Ordnance Survey. He has since carried out the proposed scheme in respect of South-west Sussex, by preparing a specimen memoir with reference to the sheets numbered 317 and 332 of the one-inch map of England. In an address to the Royal Geographical Society on the 5th of last month Dr. Mill gave an outline of his work, which consists of the following parts:—(1) *Index of all names on sheets* 317 *and* 332, *with notes on changes of name; List of Ordnance and Geological Survey maps dealing with the district.* (2) *Description of the configuration and geology of the districts, of the rivers, and of the main lines of communication.* (3) *Climate.* (4) *Woodlands and agriculture.* (5) *Parishes and their boundaries.* (6) *Distribution and movements of population.* (7) *Bibliography of the district.*

Dr. Mill described the district as including three natural regions, which together form a portion of the southern border of the Weald. These regions are the Rother valley in the north, the Chalk Downs in the middle, and the Coastal Plain in the south.

The first of these consists of Lower Greensand rocks, fully 400 feet high in some places in the north, but only 50 feet or less along the valleys of the rivers Rother and Arun. These rocks are bordered on the south by a strip of Gault clay and a narrow terrace of Upper Greensand, at levels between 100 and 300 feet. The Downs, which rise from the above-mentioned terrace in a steep and uniform escarpment, with a gradient of about one in three, reach an elevation of more than 700 feet along a narrow ridge, and descend with a slope of about one in seventeen to the south. A valley runs from east to west through the central part of the heights, but turns abruptly southward in the valley of the Lavant. The gorge of the Arun cuts through the whole mass of chalk from north to south down to sea-level. The third region consists of a level expanse less than 50 feet in height, and is formed of Tertiary sands and clays, covered here and there with drift and alluvium; the sea has extensively invaded this coast, which has now to be protected by artificial works.

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Dr. Mill pointed out that the parishes as a rule run from north to south, crossing the strike of the strata. Thus, north of the Downs the typical parish extends from the Upper Greensand terrace up to the crest of the chalk ridge, and down to the Rother river across the Gault and Lower Greensands; an arrangement which was recognised by the late Mr. Topley as generally true for the whole circumference of the Weald. In the Arun gorge the parishes do not cross the river, but overlap from east to west according to the windings of the river.

As an example of the different characteristics and productive capacities of these three divisions, the following tabular statement is interesting:—

	Plain.	*Hill.*	*Valley.*
Average elevation, . .	30 ft.	400 ft.	150 ft.
Formation, . . .	Tertiary	Chalk	Greensands
Rainfall, ...	27 in.	36 in.	34 in.
Woodlands (per cent. of area),	4	30	20
Pastures ,, ,, .	26	50	48
Arable land ,, ,, .	60	20	32
Wheat (bushels per acre), .	40	35 •	36
Density of population (per square mile), . . .	400	10	200

The numbers are only approximate, but they serve to exhibit the chief differences between the three areas. The comparison suggests that, in this case at all events, the geology of the district is the controlling influence, but Dr. Mill pointed out that just as striking differences could be found in areas of a single geological formation, and that it was the function of geography to discover the causes, geological or otherwise, which produced them.

The roads of the district are only affected by two natural features, the South Downs and the Arun valley, both of which are barriers. The Downs are crossed by road through the steep Lavant valley in the west, and by oblique valleys in the centre, but no road runs through the Arun valley in the east. This is due to the flatness of the floor of the valley, which is liable to be flooded, and to the windings of the river, which cuts cliffs on both sides. The portion of the Arun in the sheets measures 14¼ miles in a straight line, but 25¼ miles following its curves, and the railway through the valley bridges it twelve times in the ten miles between Pulborough and Ford. The open river-valley was, in fact, a much greater barrier to land traffic from north to south than was the steep range of hills.

Some of Dr. Mill's most interesting observations referred to the positions of the villages: scattered uniformly over the flat country by the sea; perched, in the Arun gorge, each on a little terrace of old river alluvium above the reach of floods, and each approached by its own road over the Downs, but connected with the others directly only by water; north of the Downs set in a close chain on the narrow terrace of Upper Greensand just under the chalk hills. The villages do not, as a rule, lie on the main roads, but each is formed at a meeting-place of by-roads.

It is to be hoped that when the memoir referring to sheets 317 and

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332 appears, it will be accompanied by some outline of a scheme by which the work, thus begun, may be organised and in time carried out for the whole of these Islands. Dr. Mill's monograph must not remain alone, a fragmentary model of how the geography of Britain should be written if there were a hundred others as competent and as willing as himself. There are men of sufficient ability and learning and industry in most districts; there are many local naturalists and archæologists and parochial historians who might be enlisted and organised in such an undertaking. It is also evident that the construction of such memoirs might be made a valuable practical discipline for senior students in universities where, as at Oxford, the study of geography receives adequate recognition. There must of course be some central organisation to lay down rules and prevent local students from straying along the lines of their own special interests away from the main theme. We understand that the whole question is under discussion by the Royal Geographical Society, and that already many volunteers have come forward anxious to take part in the work. But however Dr. Mill's lead may be followed (and the history of research goes to show that followers are not wanting when a lead is given), he has at least begun to do for the geography of Britain the same kind of service as Thorold Rogers did for its economy, by bringing it into its real relation with the concrete life of the people, and thus giving it a genuinely human interest.

THE LATE GEORGE ALEXANDER TURNER, M.D.

THE Society has experienced a great loss in the death of Dr. G. A. Turner, who took a leading part in the formation of the Glasgow Branch in 1885, and was its Honorary Secretary until the date of his death, which took place at Glasgow on the 26th of January. As a scientific man, with keen geographical interests, Dr. Turner was an enthusiastic supporter of the Society's work, and to his energy and efforts the success of the Glasgow Branch was largely due.

Dr. Turner was born at the Island of Upolu, Samoa, in the year 1845. He was a son of the late George Turner, LL.D., one of the L.M.S. earliest missionaries in the Pacific.

He was educated at the High School of Glasgow and at the Glasgow University, passing through both the University Arts and Medical courses. He was a distinguished student, and graduated M.B., C.M. in 1867, and M.D. in 1870. During his medical course he also studied divinity at the United Presbyterian Theological Hall in Edinburgh, and was ordained a minister of that Church in 1867.

In 1868 he returned to his birthplace, Samoa, as a medical missionary of the L.M.S., and remained there for nearly twelve years, till 1880, when he returned to Scotland. He was the only physician and surgeon in the group, and had a large practice, his only assistants being those trained by himself. He was placed first at Malua, and, after a few years, at Apia. In his mission work he took charge of an extensive district

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comprising about forty villages. Besides this he was pastor of the English Church in Apia. His intimate knowledge of the native dialects, the idioms of the Samoan language, and the customs of the tribes gave him special influence with the natives; and in consequence of this he was enabled to give special service to the representatives of H.M. Government during various political crises—notably during the time Sir Arthur Gordon was Governor in Fiji. In later years, in 1889, when the Berlin Conference met to discuss the Samoan question, Dr. Turner published a pamphlet on the question of the importance of British Annexation, which was of considerable assistance to the British and U.S. representatives, who availed themselves of his intimate and practical knowledge of Samoan affairs.

Having returned to Scotland he settled in Glasgow, and from 1881 till his decease he was engaged in practice in Glasgow as a physician. He devoted himself not only to his professional duties, but engaged in various church and secular work.

Dr. Turner lectured to the Society in 1885 "On the Verification of Traditions regarding the First Peopling of certain Islands in the South Pacific." He also read a paper on Samoa, in May 1899.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meeting of Council.

At a meeting held on 22nd February, the undermentioned gentleman was elected a Member of the Society, viz. :—

Charles Sarolea, Ph.D., D.Litt.

Resolutions were unanimously passed expressing the Council's sense of the loss sustained by the Society through the death of its late President, the Marquess of Lothian, K.T., and of Dr. George A. Turner, who has acted as Honorary Secretary of the Glasgow Branch from the date of its foundation.

A Resolution was also passed, awarding the Society's Medal and Diploma of Honorary Fellowship to Captain de Gerlache and Lieutenant Lecomte of the *Belgica*, as well as to Professor Chun and Captain Kreck of the *Valdivia* for their distinguished services to science in connection with the recent voyages of those vessels.

Meetings in February.

On the 8th February, in Edinburgh, Mr. W. R. Rickmers delivered his lecture on Bokhara. Mr. Rickmers addressed the Dundee, Aberdeen, and Glasgow Branches on the same subject on the 12th, 13th, and 14th February respectively.

Dr. Koettlitz read his paper on Somaliland and Southern Abyssinia in Edinburgh on the 22nd February.

Meetings in March.

Dr. Robert Laws will address the Society in Edinburgh on 8th March on the Geography of British Central Africa. Arrangements for other lectures are under consideration.

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GEOGRAPHICAL NOTES.

ASIA.

Resources of Central Laos.—This region lies to the east and north of the Mekong river, between the 16th and 20th parallels. The river is broken at intervals by cataracts and rapids, and the portion between the rapids of Luan-Prabang and those of Kemmarat has Central Laos on its left bank. Numerous navigable tributaries of this river traverse the land in every direction; the only other present means of communication consists of rough carts, but a railway from the Mekong to the Sea of Annam is vigorously advocated by a writer in the *Revue Française de l'Etranger et des Colonies* in January of the present year. The great natural fertility of the country is wasted by a decaying people. Many signs of former greatness are met with in Laos, but the rank vegetation is closing over the ruins of imposing pagodas and palaces, and legends and songs are all that are left of the history of a nation. The indolent inhabitants, who live chiefly on rice, work perhaps a fortnight in the year for their crop; and whoever would develop the land must import labour from China or Annam. The sugar cane, maize, and cotton grow well, but are hardly worked at all; silk is produced all along the Mekong; and, as the river shrinks in its bed, tobacco is pricked out in the fertile mud, and produces a leaf which is noted for its flavour. Iron seems to be plentiful, and is worked with skill but not with industry. The chief trade of the people lies in the export of skins and of the most fantastic drugs for the Chinese market—powdered horns of deer for languor and depression, to be taken mixed with alcohol, is the most intelligible of these remedies; rhinoceros horn and the bones of tigers give courage and strength. Silk and cotton stuffs are got from England and Germany; iron, steel, and domestic articles from China.

AFRICA.

White Population of German South-West Africa.—The statistics of population as at January 1, 1899 may be given in the following tabular form:—

	Adult Males.	Total.
Of German nationality, . . .	1557 or 85%	1879 or 65%
Boers, ...	140 or 8%	637 or 22%
British, ...	98 or 5%	278 or 10%
Others, ...	45 or 2%	78 or 3%

It will be noticed that the Boers, and to a less extent the British have families, and would appear to be permanent settlers. Indeed, Herr Paul Langhans, who writes on this subject in *Petermann's Mitteilungen*, goes so far as to say that the Boers form the only true landholding white population of the colony, for while they afford only eight per cent. of the grown men, they include no less than forty-seven per cent. of the women and children. On the other hand, a comparison with the statistics of three years before shows a slight falling-off in the total number of the Boers, many of those who came into the country having found the conditions unfavourable for them.

Resources of Abyssinia.—A recent report from M. Lagarde, French Minister in Abyssinia, describes the trade which passes through Harar. This town is about 180 miles from the coast (caravans take a month to the journey), and is the meeting-point of roads from Jibuti, Zeila, and Berbera. Mr. Weld Blundell, describing Harar, says that it would be hard to imagine a more beautiful situation; "it stands

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5400 feet above the sea, with every condition that makes for wealth and prosperity —fertility of soil, industrious agricultural population, and central position, and what is so rare in the catalogue of advantages of an African town—with an extraordinarily healthy and invigorating climate." M. Lagarde gives its population as 40,000, of whom 15,000 are Abyssinians, 17,500 Hararis, 6500 Gallas and Somalis, and 1000 Arabs, Turks, Armenians, and Indians. There, as in Abyssinia, they use the dollar with the image of Maria Theresa on it, and the Indian two-anna piece for change. Bars of salt are the means of exchange in the Ethiopian regions. But Menelik has recently struck dollars with his own image, and these, with his smaller coins, are coming into use. The land of Harar is largely uncultivated. Almost all the trade of Abyssinia goes through Harar, the other routes, *vid* Massowah and the Soudan, carrying very little, though we may now look for a change in respect of the latter. Abyssinia produces coffee, civet, ivory, gold, wax, and skins for export; for home consumption, wheat, maize, millet, teff, barley, and cotton. Horses and mules of a vigorous and sturdy type are bred. The uncultivated coffees have an excellent aroma; little is consumed, but 2000 mule-loads of 108 kilos each pass every month through the customs at Addis-Abeba. Coffee is cultivated at Harar, and about 300 camel-loads of 270 kilos each pass monthly through that town to the coast. The ivory forms an important part of the revenues of Menelik: from 30,000 to 40,000 kilos are sent in yearly as tribute by governors and vassal kings; pure gold in rings or ingots comes into his treasury in the same way. The cost of transport is so high that the export of bulky stuffs is impossible. All manufactured articles—sugar, soap, etc.—are imported at Jibuti by half a dozen European and Armenian houses, to the extent of about 1,000,000 francs a year. Salt, petroleum, iron, and steel are imported by the Somalis. There is practically no industry throughout Abyssinia, except for the manufacture of swords and knives, and of a cloth of silk and cotton. The French expect that the railway from Jibuti to Harar will secure almost all the Abyssinian trade for their colony; at present, Jibuti, in spite of its fine harbour, does less trade than Zeila. In the last ten years the trade of Abyssinia has increased tenfold, and it may be expected to develop even more rapidly within the near future.

Casamance and its Produce.—About 170 miles south of Cape Verd, and 12½ degrees north of the Equator, is the mouth of the river Casamance. Its westerly course is roughly parallel with the boundaries of British Gambia to the north, and Portuguese Guinea to the south. The strip of country through which it flows, let us say 50 miles wide by 200 miles long, produces several grains, rice, cotton, indigo, rubber, palm-oil, and wax. M. Adam, the Colonial Administrator, has published a very clear report of observations and experiments. The middle and lower stretches of the river are unusually suitable for rice culture, the land is annually inundated, and only labour is wanting. The Diolas, wholly barbarian, do not see why more rice should be grown than can be eaten; other natives may be tried, but it is doubtful whether they would work; and M. Adam falls back on the old Congo idea of a penal settlement and forced labour. Rice is sown in June; next month the fields are prepared by furrowing and ditching; in August, when the water begins to overflow, the seedlings are planted out; the harvest is at Christmas. Great fields of cotton, hedged by thorn or bamboo, are useful only to the natives, because the fibre is too short for European industrial use, and attempts to make them grow a better variety have been only partially successful. A species of Landolphia, a liana of a somewhat bushy habit, gives a first-class rubber; it is widely distributed, although the natives have treated it very severely. Other creepers abound, but their product does not coagulate so well. Although these

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lianas grow on any soil, the most favourable positions are damp and shady, and these conditions prevail over almost all the territory. A creeper of average size will give you from six to ten shillings worth of rubber annually; the best time for getting it is at the end of the rains. The amount exported yearly varies from 160,000 to nearly 400,000 kilos.

Forests of Tunis.—The northern parts of Tunis are very heavily timbered chiefly with cork trees. These forests, until French rule had been established, were the home of a people who were never subjugated by the titular government. In 1884 the lands were declared the property of the administration, and the gathering of cork and tan was organised on sound lines. The Board of Forestry marks out lots in the woods and sells the harvest to contractors, who are chiefly Italians. The authorities are taking care to improve the supply of other trees which do not offer an immediately remunerative return. M. du Fresnel, who writes on this subject in the *Bulletin de la Société de Géographie Commerciale*, finds that most of the cork goes to Algeria, while Italy comes second, and France a bad third. It appears to him a regrettable thing that so much of the products of this French colony should go to other than home markets. This idea, which is surely fallacious, is common among French writers on colonisation.

AMERICA.

Climate of Mexico.—The following note of the meteorological readings recorded during 1899 in the Central Observatory, Mexico City, has been communicated to us by Mr. R. Hay Anderson:—Mean temperature in shade, 15·6 C.; in open air, 16. Maximum in shade, 30·9 (April); minimum, 2 (Dec.). Maximum open air, 34·6 (April); minimum, 3·4 (Dec.). Maximum daily range in shade, 18·5; in open air, 29·2 (both April). Variation during year in shade, 28·9; in open air, 38. Mean atmospheric pressure, 585·67 mm.; maximum, 590·57 mm. (Jan.); minimum, 580·82 (Nov.). Maximum daily variation, 5·18 mm. (April); minimum, 1·39 (Nov.). Prevailing direction of wind, NW. Maximum velocity of wind in June from N., 18 m. Prevailing direction of clouds, NE. Number of cloudy days, 130; of clear, 98. Mean tension of vapour in shade, 7·84 mm. Mean humidity of air in shade, 57%. Mean daily evaporation in shade, 2·2 mm.; in open air, 6 mm. Maximum evaporation in one day in shade (Jan., Feb., March, April), 4 mm.; in open air (April), 12 mm. Mean temperature of water in shade, 12·5 C.; of soil, 1 m. deep, 15·4 C. Total rainfall, 581·1 mm.; maximum rainfall in 24 hours (Sept.), 27 mm. Number of tempests in years, 23. Rains accompanied by hail, 7. Number of days with rain, 155. Hottest month, May; coldest, Jan. and Dec. Month of highest bar. press., September; of lowest, February. Windiest month, May; cloudiest, June; clearest, February. Greatest average rainfall, September; least, April. The year was normal, the statistics differing but little from the general average of twenty-three years. During the year there were several earthquakes, the first on the 13th of January; and on the 24th of the same month there were two, one in the morning and the other in the afternoon, the latter being one of the strongest registered in this observatory. Slight movements took place on the 4th and 11th Feb., 25th March and 17th Dec., the last being extremely slight.

The Panama Canal.—The Nicaragua scheme will find it difficult to compete with this rival. Two-fifths of the work have been completed, and the engineering surveys for the whole have been very fully carried out during the time of enforced inactivity. A good deal of the once excavated canal has been silted up,

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but the clearing of it again presents no great difficulty. Several thousand men are daily at work on the Culebra cut, which is stated by Mr. Charles Paine in the *Engineering Magazine* to be the greatest excavation ever attempted. The New Canal Company, on taking over the work, found immense stores and plant over the whole course of the canal. The isthmus, along the line of the railroad, is covered with dwellings, sidings, contractors' plant and materials of every description. The scale upon which things were done by the first company may be judged from the fact that a beautiful group of buildings was erected as an hospital at a cost of two million dollars, as well as other sanatoria. Four hundred and twenty locomotives, and several large machine shops and well-furnished warehouses, were found but little depreciated by the new company. The country is not, as was feared, remarkably unhealthy; the care with which inhabited places were drained has preserved the population from the diseases associated with many tropical places. The history of the Panama canal shows much actual work accomplished, and the amount that remains to be done can be accurately estimated. The same cannot be said of the Nicaragua scheme, which is still in a most embryonic form. "Since 1893," wrote Mr. Henry Hunter last year, "the financial situation has been bad. It has been difficult to obtain money, and but little work has been executed. Prior to that date a length of 1000 feet of pier-work had been constructed at Greytown, a channel had been dredged on the foreshore, and some three-quarters of a mile of the canal had been formed by dredging in the low swampy ground. A single line of railway had also been formed across the lagoon, from Greytown to the site of the first lock, the length of the line being about 11½ miles. These works, with the addition of certain telegraph lines, represent the sum-total of the efforts which have been made to construct a waterway on the Nicaragua line." The report of the Commission which is now investigating the rival schemes will be awaited with interest.

GENERAL.

Conference of British Geographical Societies.—The Societies, represented by delegates, met on June 6, 1899, at the house of the Royal Geographical Society. The Scottish Society was represented by Professor Butcher. Sir Clements Markham, who was Chairman of the conference, suggested certain directions in which joint discussion and action among the several Geographical Societies might be advantageous. Such, for instance, were: the collection of funds for the Antarctic expedition; the discussion of matters relating to geographical education, the supply of Ordnance survey maps, the study of commercial geography, etc. After some discussion the following resolutions were passed:—"That this meeting of delegates from the Councils of the Geographical Societies is of opinion that there are several branches of their work which would be advanced by occasional conferences"; and "That a conference be held for this purpose at the office of the R.G.S. on the day following the annual meeting of the R.G.S., 1900." It was further agreed to send the Chairman's address and the above resolutions to the Councils of the various Societies, inquiring whether in their opinion these meetings should be annual or occasional, or both; asking for their views as to occasionally holding meetings of the conference in the country, and inviting them to suggest subjects for the consideration of the conferences. To this circular the Council of the Royal Scottish Geographical Society has replied that in their opinion the proposed conferences should be held when any subjects of especial interest should arise which might advantageously be discussed by such conferences; that they have no subject of this nature to bring forward at present; and that the meetings, when necessary, should, in their opinion, be held in London.

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Oxford School of Geography.—The full course of instruction extends over one academic year. It is assumed that those entering upon it have a general knowledge of descriptive geography. Instruction is given in the following subjects :—The principles and chief facts of geomorphology ; rivers and river-basins ; the coastal belt ; mountains ; areas of elevation and depression. Surveying, as practised by explorers ; the use of the plane table, the prismatic compass and the theodolite. The geographical co-ordinates ; map projections on the plane, the cylinder and the cone, and their commoner modifications. The determination of position by astronomical methods ; simple observations for latitude, longitude, and true bearing ; the reduction of such observations. The reduction and generalisation of maps ; plotting of observations ; methods of depicting land-relief ; compilation of statistical maps. The distribution of solar energy on the rotating earth and the resulting circulations of air and water ; the modifying effects of the distribution of land and water. Meteorological and hypsometrical observations. The climatic provinces of the earth ; compilation and use of charts of weather and climate. The physical conditions of the oceanic abyss, and the methods of observing and representing them. The chief generalisations regarding the distribution of animals and plants, according to species and to associations. The chief facts of anthropogeography ; the geographical distribution of men according to number and to race ; the influence of physical features in determining the position of settlements and roads. Outlines of the historical geography of Europe and the Mediterranean lands, considered in relation to the physical features, more especially from strategic and economic points of view. The history of geographical ideas ; outlines of the history of discovery ; the distribution of place-names in the old continent according to origin and meaning. The instruction in the above subjects is both theoretical and practical.

A Condition of Empire.—The following resolution was passed by the German Colonial Society, at its recent meeting at Strasburg :—"The rapid increase of our colonial possessions, and the growing part which Germany plays in the commercial development of all parts of the world, lay upon us new duties with regard to the education of our people. It becomes more evident every day that we need the systematic teaching of ethnology at our universities ; our chairs of geography are no longer sufficient in number for their increasing tasks. If we are successfully to administer and to cultivate those regions which have come within the sphere of our colonisation and our trade we must be equipped, not only with the most thorough knowledge of physiography, but also with an accurate acquaintance with the manners, customs, ways of thinking, and state of culture of those peoples with whom we come in contact. The best preparation for our work lies in the study of those modern ethnological and geographical sciences which, more than any other, are in living and intimate touch with the present colonial development of our nation. That our system of higher teaching should fail to recognise the adequate place of geography is even dangerous. In order, therefore, that our rising generation, on whom the consolidation of "Germany beyond the Sea" will fall, may not lack that genuinely scientific knowledge which alone is sufficient for this great task, we deem it imperatively necessary both that the chairs of geography should be increased in number, and that special professorships of ethnology should be established in our universities and technical and commercial schools."

The Paris Society of Commercial Geography is organising an International Congress of Economic and Commercial Geography, which will meet from August 27th to August 31st in the **Palais des Congrès**, Paris. The subscription of ten

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francs secures admission to the congress, as well as the reports of proceedings, which will be published. The subjects of study will be:—Explorations, commercial routes, natural and manufactured products, emigration, colonisation, teaching. Communications on subjects relative to the above are invited. The offices of the Organising Committee are at Rue de Tournon 8, Paris.

NEW BOOKS.

Mongolia and the Mongols. Results of a Journey in Mongolia performed in the Years 1892-1893. By A. Pozdnieëf. Tome 2. (In Russian.) St. Petersburg: Press of the Imperial Academy of Sciences, 1898. Pp. xxix + 517.

We have lately received this, the second, volume of work already noticed in vol. xiii. p. 220. After a sojourn in Pekin, M. Pozdnieëf returned to Urga by Kuku-khoto, Dolon-nor, the Dalai-nor, and the valley of the Kerulen. Making thence another excursion to the Kerulen, and passing over to the valley of the Onon, he crossed the Siberian frontier to Ulkhun. M. Pozdnieëf's observations are chiefly concerned with the people, their homes, and occupations, the history of places on the route, and their antiquities, and, being well acquainted with both the Chinese and Mongul languages, he has collected much interesting information on these subjects.

In the introduction an account is given of the schools for modern languages, and European learning established in Pekin after the Anglo-Chinese war of 1860, and of the Russian missions.

Dans la Grande Forêt de l'Afrique Centrale. By Franz Thonner. Translated from the German. Pp. x + 115. With 86 Plates and 3 Maps.

The expedition described in this volume was made in the year 1896, when the Congo Railway did not extend within eleven days' march of Stanley Pool. The author's route after ascending the Congo to Mongo was in a northerly direction to the Dua, which he explored throughout its navigable course, and then down the Mongalla river to its confluence with the Congo. He does not profess to be breaking new ground, for though he mentions a visit to one district which he was informed had not before been traversed by a white man, it did not take him more than a day or two's march from a station. Mr. Thonner's objects in undertaking the journey were chiefly botanical and anthropological, but his book forms a sort of Baedeker, a little monotonous it must be confessed, which will be useful to any one desirous of following in his footsteps. It may be mentioned for the benefit of such that the natives are mostly cannibals. But by far the most valuable part of the volume consists of the photographs reproduced in it. These are admirably selected and of great interest, showing types of scenery, of native villages, and of the various tribes with their characteristic attire and ornaments—the two are occasionally synonymous. There are also tables of meteorological and linguistic observations, which attest Mr. Thonner's industry during his two and a half months' stay in the country. While the work deals only with a particular district, and does not touch questions of comparison with other regions, it is of distinct value as regards the features of that district, and supplies material for comparative study. A noticeable feature of the country is the number of mission stations established along the river.

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The New Pacific. By HUBERT HOWE BANCROFT. New York: 1900.

This volume may be regarded as a continuation of Mr. Bancroft's well-known works on the History of the United States, for it contains a narrative of the leading incidents in the recent war of the States with Spain, and a lengthened exposition of the vast, varied, and world-wide results with which, he conceives, the victory of the States in that war will be attended. Foremost among these results may be placed the abandonment by America of her traditional policy of isolation, necessitated by her acquisition of colonial dominions thousands of miles distant from her shores, and situated where all the great Powers of the world have large interests at stake, which they guard with the utmost jealousy. The author calls his work *The New Pacific*, because he anticipates that the possession by America of the Philippines will create a new order of things in which the Pacific, emerging from its hitherto comparative obscurity, will become the great highway and centre of the world's commerce even as had been the Mediterranean in old times, and as is the Atlantic at present. To quote his own words: "Around the shores of the Pacific, the greatest of the world's waters, are now circling the world-currents of progress, instinct with thought and energy. All the elements, earth, air, and water, breathe of activity and life. The civilisations of the future will cluster here, and become merged into one civilisation, with this ocean as a common centre, across and around which swift intercourse will bring the various parts into near relationship" (p. 333). From the sentences with which the volume opens, it may be inferred that even already the Pacific has made some progress towards the realisation of this glorious destiny. "A dozen lines of steamships, or thereabouts, now cross the Pacific between America and Asia, where for two and a half centuries a single galleon made its slow and clumsy way forth and back from Acapulco to Manila once a year. Ships, comprising scores of lines, ply along shore, unite the islands and mainland, or sail direct for foreign ports." In this connection we are told that the centre of the United States has already been moved from Kansas to California, where the Golden Gate of her spacious bay will be an open door to the commerce of all the world. When we consider indeed the enterprise and energy characteristic of the Americans, and the vast extent and vast natural wealth of the regions on both sides of the Pacific, and the countless number of fertile islands in its bosom, a marvellous expansion of commerce in its waters seems to be inevitable. This expansion, Mr. Bancroft thinks, will by its very magnitude change our old ways of looking at things. "And this new birth," he says, "comes at a most propitious time. America is ripe for it; the world is ripe. The day of great things is past . . . all things have become mediocre or small. No more great seas or lands; no more great enterprises; no more great fortunes or great men. So that when it comes to the political and industrial subjugation of this sea, achievements which would have been regarded at one time as stupendous or impossible, will not seem now extraordinary or of uncommon occurrence." The prospect here set before us of a time coming when the world will be reduced to one dead level of commonplace, and there will be nothing left us to wonder at, is far from cheering.

The work is divided into thirty chapters of which the first twelve deal with the war in its various aspects—the moral and the political as well as the military. In the fourth chapter we are presented with a clear, bright, and effective narrative of the memorable naval engagement off Manila, in which Commodore (now Admiral) Dewey at one fell blow destroyed the Spanish fleet, and emancipated the Philippines from Spanish domination. In the next two chapters our attention is directed to the naval and military operations in and around Cuba, and in that

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which follows to the effects produced on the minds of the Americans by the signal triumph of their arms. They had entered on the war with no definite object in view, further than to put an end to the intolerable state of things which had so long existed in Cuba; but when they found that in achieving that object they had besides acquired large foreign possessions and had in fact become a great world-power they were at first bewildered and beyond themselves with exultation at the rapidity and magnitude of their success; and when thereafter they began to consider with more or less calmness the new situation thrust on them, they awoke to a sense not only of the great responsibilities it involved, but also of its far-reaching consequences and possibilities. Then arose the all-important question, What was the Republic to do with its conquests? Should it abandon them and continue to adhere to its old traditional policy of isolation, or should it avail itself of the means of expansion placed within its grasp and become a great imperial power, taking its full share with the older nations of the world in the general control of its affairs? Each of these policies had numerous and ardent partisans, and our author sets forth with admirable point, force, and fulness the arguments employed on each side. The policy of expansion or imperialism he strongly favours, and is that which has most commended itself to the minds of his countrymen. The middle section of his work (chaps. 13-25) is that in which we find the grounds on which he bases his anticipation that the world's commerce will gradually gravitate westward until the Pacific becomes its supreme seat, and the countries which line its shores be united in one vast Industrial Empire (or should we rather say Republic?) of which America will be the inspiring soul as well as the predominant partner. This part of the work may be regarded as a repertory of geographical information gathered from numberless sources regarding the islands of the Pacific and the countries which border it, from Patagonia to Alaska on the one side and from Behring Strait to Australia and New Zealand on the other. The geographical details are all the more interesting and instructive since they are viewed in relation to the interests of industry, commerce, and politics. The description of America's new acquisitions in the Far East, the Philippine islands, 1400 in number, will be read with special attention. The last five chapters treat of Voyages into the Pacific, Crusoe island, Pirates in the Pacific, the South Sea terrestrial paradise, and the Legend of Calafia, the Queen of California. The work is supplied with a useful map and a good index.

The Real Malay. By Sir FRANK ATHELSTANE SWETTENHAM, K.C.M.G. London and New York: John Lane, 1900. *Price 6s.*

In former numbers of this *Magazine* we had much pleasure in recommending to our readers the works of Mr. Hugh Clifford, who we are glad to see has been lately appointed Commissioner of North Borneo, and we have now to welcome Sir Frank Athelstane Swettenham as a worker in the same mine. The volume now before us compares favourably with any of those of Mr. Clifford, and presents many points of contrast and resemblance to them. Sir Frank has the same genuine sympathy for the Malay, the same intense interest and deep insight into his character, and the same enthusiasm in his subject which are so conspicuous in Mr. Clifford's works. He has also the keen eye of a true lover of nature, and the graceful, facile pen which can faithfully describe the wonderful scenery of the Malayan peninsula, and the not less wonderful workings of the Malayan mind. Like Mr. Clifford he writes from his own experience and with the ease and assurance of a master of his subject, and we observe that the two authors corroborate each other in their delightful descriptions of the salient characteristics of the people whom they know so well.

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By way of introduction to his most interesting budget of stories, Sir Frank has devoted a chapter to a description of the position and work of the administrative officers of Government since 1874, when, for the first time, Malaya was really brought within our sphere of influence; and this chapter is a skilful exposition of the action of his brother officers under peculiarly difficult circumstances, *i.e.* when they were held responsible for good administration and government in places where nominally they had no real authority and could only give advice. Most justly may he say that "the qualities required were courage and resource, combined with a tireless energy, sympathy with the people of the land, their customs and prejudices, and that enthusiasm for the work intrusted to them, that determination to compel success, which is characteristic of the class which sends its sons to the uttermost parts of the earth to preach the gospel of freedom, justice, and British methods of administration." Some of the more noticeable results of a quarter of a century of British control are one hundred and seventy-five miles of railway with rolling stock, more than two thousand miles of good roads, and a thousand miles of telegraphs all made and paid for out of current revenue, five important schemes of water-works completed, and great improvements in irrigation. "Lighthouses have been erected, wharves provided, prisons, hospitals, schools, barracks, and handsome public offices constructed. A trigonometrical survey of the Western States is being pushed on, public gardens have been laid out, and museums instituted. A good deal has been spent on experimental agriculture, and the States are alive to the immense importance of encouraging all forms of permanent and profitable cultivation." In 1875 the income was under half a million dollars; in the present year it will exceed eleven millions. No wonder that Sir Frank is proud of his service, of which with characteristic moderation he says, "there is just as high a standard of honour and honesty (and he might have added, efficiency) amongst the European officers of the protected Malay States as in any other society of English public servants."

Rajah Brooke. By Sir Spenser St. John, G.C.M.G. ("Builders of Greater Britain Series.") London: T. Fisher Unwin, Paternoster Square, 1899. *Price 5s.*

It is true it is only in a limited sense that we can accept Rajah Brooke as one of the Builders of Greater Britain, but his biographer can fairly claim that "he was the cause of large territories being brought within our sphere of influence." In many respects he resembled Sir Stamford Raffles, whose title to be a Builder of Greater Britain rests on the annexation of Singapore, a port which for a long time cordially distrusted the Rajah, and did its utmost to thwart his endeavours to attract trade to Sarawak. Both of these Englishmen met the same fate at the hands of an ungrateful and unappreciative Government at home; but Rajah Brooke was more fortunate than Sir Stamford, for he handed on his acquisition to his nephew, who still rules the northern tract of Borneo. The Rajah is fortunate in his biographer, Sir Spenser St. John, who began his own distinguished career in 1848 as the Rajah's secretary, and is admittedly from first to last his enthusiastic admirer and supporter. But after making every allowance for the personal esteem and even affection which the Rajah inspired, alike among his own circle and among the natives with whom he came into contact, we can easily see that he was a man of whom the nation is and ever will be greatly proud, and who is entitled to high rank in the glorious roll of proconsuls who have served England in the East. He was tried by adversity rather than by prosperity. In Sarawak he had to be the pioneer of elementary civilisation among savage tribes and ruthless

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pirates, and a great part of his work had to be done single-handed. Had his proposals and suggestions to the Government of his day been carried out even in a modified form, the position of England in the Malay archipelago would be very different from what it is to-day. But the period of his best work in Sarawak coincided with that when the idea of expansion of the empire was abhorrent to the authorities at home, and what he did he had to do rather against the will of the Government than with its approbation and assistance. Had he been more of a politician, more pliant in principles, more cautious in expression, he would have fared better at the hands of the home authorities, but he would not have been Rajah Brooke, the fearless, simple-hearted, impetuous, improvident, but generous gentleman, trusted and worthy of trust by both friend and foe, and in every sense "a great and wise and good ruler" of men.

In the last two chapters of this work, Sir Spenser St. John gives us an interesting account of the present condition and prospects of Sarawak and North Borneo, neither of which seems to be in a prosperous or satisfactory condition. He puts his finger on what are *prima facie* serious errors of policy and administration which well merit the careful attention of the local authorities.

A New Ride to Khiva. By ROBERT L. JEFFERSON, F.R.G.S. London: Methuen and Co., 1899. *Price* 6*s.*

It is probably needless to say that Mr. Jefferson, in his bicycle ride to Khiva, had no intention of geographical research or exploration. His book is merely a record of his own experiences as a cyclist on unbeaten tracks, and as such it appeals to but a limited audience. On the other hand, his experiences and adventures are well told, although not very novel. He confirms what has been commonly reported of Khiva, that under Russian domination it is rapidly falling off in population and political importance, and has little chance of ever again recovering its former position. We can commend the book as a spiritedly written account of a plucky and adventurous journey in lands where Englishmen rarely ever go, although when they do go they are always made very welcome.

Quaint Corners of Ancient Empires—Southern India, Burma, and Manila. By M. M. SHOEMAKER. New York and London: G. P. Putnam's Sons, 1899. Pp. 212. *Price* 10*s.* 6*d. net.*

Mr. Shoemaker belongs to that large class of Americans who travel, and he is deservedly severe in his remarks on those of his countrymen, "many of whom have been sent to Congress," who do not travel, and who consequently are apt to form wrong opinions on things in general, and regarding Britain in particular. He also expresses surprise and regret that Germany has evinced so little friendliness towards the United States, and ascribes it to the Germans wanting the Philippines for themselves, and feeling enraged "to have their entire plan thwarted by America in one single May morning."

The author's chapters recording his experiences in the Philippines will be read with much interest, for his chatty style is supplemented by much solid information, whilst the many excellent illustrations the book contains make it a very attractive one.

As occurred during the Scottish Reformation, the friars of the Philippines have been confronted by a popular uprising, their vices have been exposed, their churches destroyed, and many have fled the islands. Indeed, Mr. Shoemaker assures us, that, but for the American garrison, these friars would be slaughtered

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to a man by the people they have misruled for centuries, from whom they have extorted enormous wealth which they still possess, and who now hate them with all the bitterness of outraged ignorance and innocence.

Fifteen Years' Sport and Life in the Hunting-Grounds of Western America and British Columbia. By W. A. BAILLIE-GROHMAN. London: Horace Cox, 1900. Pp. 403. *Price* 15*s. net.*

This very handsome and valuable volume is the result of the author's residence on the Pacific Slope of North America, and his devotion to big-game shooting, salmon-fishing, etc. He is more, however, than a mere sportsman, for he studies scientifically the products of his chase. Thus he figures and discusses the anal fin respectively of the European salmon (*Salmo*) and the quinnat (*Oncorhynchus*), one of the various species of salmon in the waters of the Pacific Slope. He also criticises Dr. Günther's statement that a white-fleshed quinnat is "unfit for canning purposes," and ascribes such a statement only to "a stupid prejudice entertained by European consumers who will persist in demanding red-fleshed fish," and remarks, after fifteen years' experience, that "the white-fleshed, fresh-run quinnat is quite as good as the red one; in fact, the opinion that it has a more delicately flavoured flesh is shared by many connoisseurs on the coast." However, owing to the "stupid prejudice" above-mentioned, an enormous waste occurs, the white fish being ruthlessly thrown away when canning occurs for European markets.

Other chapters are devoted to carefully detailed descriptions of the wapiti, its antlers, and its chase; the antelope goat of the Pacific Slope mountains and its chase; the moose, caribou, and deer of the Pacific Slope; the bighorn and the antelope; the bears and the bison of North America; and the seal and other fur-bearing animals of the Pacific Coast. Mrs. Baillie-Grohman contributes a chapter on "The Yellow and White Agony," in which she narrates her troubles with Chinese and white servants. Compared with an average plain cook, or an inefficient housemaid at home, she declares that John Chinaman "does twice the work, he is far more cleanly in his manner of doing it, he is always sober, and fairly honest."

The volume is admirably illustrated by seventy-seven photographs, including the best trophies of North American big game killed by English and American sportsmen, with a table of measurements and notes, whilst three specially prepared maps of the north-west coast of the United States, British Columbia, and the Kootenay district are appended.

Narrative of a Journey in Western China. By G. E. GRUM-GRZHIMAILO. *Vol. II.—Across the Pei-Shan and Nan-Shan to the Valley of the Yellow River.* (In Russian.) St. Petersburg: The Imperial Russian Geographical Society, 1899. Pp. 445.

The first volume of the travels of the brothers Grum-Grzhimailo was published in 1896, and was noticed in vol. xii. p. 492. The work was to have been complete in two volumes, but so much remained to be recorded that a third volume is to be issued. This second volume treats of the journey from the eastern border of the Khami oasis to the Kuku-nor and the Upper Hwang-ho, and the march homeward is left for the third volume. Besides the observations of the travellers, a sketch of the history of the Pei-Shan region in connection with the history of Central Asia, occupies two chapters, and in a chapter on the red-haired Autochthones of Central Asia, the author deals with some ethnological problems.

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The narrative is an important addition to the geographical literature of Central Asia, and is a book which should be consulted by all students of Central Asia. It is well got up, and adorned with many good illustrations and a map, and is worthy of the Society which publishes it.

Guide to Queensland. Compiled from Official and Private Records, with the recognition of the Hon. Sir Horace Tozer, K.C.M.G. By CHARLES S. RUTLIDGE. Map and Illustrations. London: Dean and Son, 1899. Pp. 167.

Western Australia; its Position and Prospects. By GRANT CHAMBERS. Map and Illustrations. Perth: by authority: R. Pether, Government Printer, 1899. Pp. 151.

The above two works are specially designed for the information of intending emigrants. They summarise the advantages presented by each colony for the guidance of those in the old country who want a new sphere for their energies and industry. They may also serve as a useful guide to the capitalist who wants reliable information regarding the commercial possibilities of these new fields for enterprise. In each case the handbooks have been brought up to date and the accuracy of the information is vouched for by government authority.

NEW MAPS.

ASIA.

CHINA, Atlas du Haut Yang-tse de I-tchang-fou à Ping-chan Hien par le R. P. S. Chevalier, S. J. I^er^ Fascicule de I-tchang-fou à Tchong-king-fou.
Observatoire de Zi-ka-wei. Shanghai, 1899.

This is a work which should be of considerable interest and value to all concerned in the opening up of China, especially the Valley of the Yang-tse. It is however somewhat anomalous that the mapping of our British sphere of influence should be left to the enterprise of French Jesuit priests. Nevertheless we ought to be grateful for such an important piece of work, although it may well raise the question as to whether the mapping of our spheres of interest might not fairly be expected from a much-to-be-desired Intelligence Department associated with our Foreign Office. If we establish spheres of influence in countries like China where there are no existing surveys, surely our first duty is to map them, and to ascertain their commercial, political, and strategical resources.

The first section of the Atlas comprises a river survey of the Upper Yang-tse from I-chang-fu to Chung-king-fu on the scale of two and a half inches to the mile. The river is mapped at its lowest water level and numerous soundings in metres are given all along the channel. The hills and elevations along the banks are shown by contour lines, and the nature of the soil, whether sand, shingle, stones, low rocks, or high rocks and cliffs, is distinguished by characteristic markings in black. This could have been much more effectively shown by colours, but probably expense in production was a consideration. Villages, houses, and temples are all clearly marked, and the names and descriptive lettering are given in Chinese, English, and French. The Atlas is accompanied by a volume of text, copiously illustrated by views and diagrams, describing in detail the course of the river, and the trade and resources of the countries through which it passes. We cannot but congratulate the Jesuit Mission on the first instalment of this splendid work.

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AFRICA.

NIGER, Cours du Niger de Tombouctou à Boussa. Levé expédié, exécuté en 1896 par M.M. Hourst, Lieut. de Vaisseau, Baudry, Enseigne de Vaisseau, et Bluzet, Lieut. d'Infanterie de Marine. Scale 1 : 50,000. 50 Sheets. Service Géographique des Colonies, 1899.

Publié par le Service Hydrographique de la Marine, Paris.

These maps display an activity in French colonial cartography which might well be emulated by our British foreign and colonial services. Although only a preliminary survey, yet this work is a most valuable aid towards the development of river navigation in this rich country. The map consists of fifty sheets showing the course of the river in considerable detail on a scale of about an inch and a quarter to the mile. Along the channel of the river frequent soundings are marked, and sandbanks, rapids, and features of importance to navigation noted. On the banks the leading characteristics of the country and landscape are noted. Hills, villages, woods, and tracts of cultivation are sketched in, and numerous heights are given.

UPPER NIGERIA, Carte de la Mission Blondiaux, 1897-98. Scale 1 : 250,000. Service Géographique des Colonies. 4 sheets. *H. Barrère, Paris.*

This map includes the region of the Upper Niger basin formerly known as 'Samory's Empire.' Drawn on the scale of about four miles to an inch, it is a good general map, and, for a preliminary survey, represents an amount of detail which is very creditable to the cartographic enterprise of the Mission. The physical features of the country, villages—old and new, ruins, cultivation, and roads or tracks are all clearly shown. Considering that this is an original map, and the latest authority for this region, it is a serious fault that it should lack scientific precision through the omission of the lines of latitude and longitude.

SOUTH AFRICA. Military Sketch of the Biggarsberg and of the communications in Natal, north of the parallel of Ladysmith. Scale, 4 miles to an inch.
Intell. Div. War Office, No. 1442.

Sketch Map of country round Ladysmith. Scale 1 : 126,720 or 2 miles to an inch.
Intell. Div. War Office, No. 1449.

Sketch Map of country round Kimberley. Scale 1 : 250,000 or 3·94 miles to an inch.
Intell. Div. War Office, No. 1367.

Sketch Map of country round Hopetown. Scale 1 : 250,000 or 3·94 miles to an inch.
Intell. Div. War Office, No. 1367.

These maps are specially published for field use in connection with the war. They are merely sketch maps with detail very insufficient to be really useful for military purposes, but they represent the only surveys available. The variety of scales adopted for the maps of the Intelligence Department is somewhat unaccountable.

ATLASES.

ROYAL ATLAS OF ENGLAND AND WALES. A complete series of Topographical Maps, Physical and Statistical Charts, Town Plans, &c. Edited by J. G. Bartholomew, F.R.G.S. *Price in cloth, 16s. net.*

George Newnes Ltd., London.

This work comprises, in 35 section maps, a complete reduction of the Ordnance Survey of England and Wales on the scale of four miles to an inch—a scale

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sufficiently large to show all the principal roads, villages, hamlets, mansion-houses, and leading features of topographical interest. This reduced survey is accompanied by a general index of 35,000 names. There are also numerous plans of the principal towns, and an interesting series of physical and statistical maps with accompanying text. Altogether the Atlas forms a most complete compendium of the Geography of England and Wales, and should be invaluable as a reference work. It is published at a price which ought not to interfere with its popularity.

MURRAY'S HANDY CLASSICAL MAPS. Each with separate Index. Edited by G. B. Grundy, M.A., of Brasenose College, Oxford.

Gallia: Scale 1 : 2,500,000.	*Price* 1*s. paper*, 2*s. cloth.*
Britannia, Scale 1 : 1,400,000.	do.
Hispania, Scale, 1 : 2,500,000.	do.
Italia Superior, Scale, 1 : 1,200,000	Two sheets in one case.
Italia Inferior et Sicilia, do.	*Price* 1*s.* 6*d. paper*, 3*s. cloth.*

John Murray, London.

Physical and orographical maps are now considered necessary for the intelligent teaching of Modern Geography, but hitherto Classical Geography has been taught without them. It stands to reason that if a scientific teaching of Modern Geography demands their use, they must be equally indispensable as a key to the study of Ancient Geography. Mr. Murray's series is the first in which this has been attempted. It consists of a selection of maps from that standard work *Smith's Classical Atlas*, and the prominent characteristic is the basis of physical colouring upon which the political features are superimposed.

The maps have been revised and edited in accordance with recent research by Mr. G. B. Grundy of Brasenose College, Oxford. Each map is supplemented with a complete index. In their new garb of Physical colouring they have been produced by Mr. Bartholomew of Edinburgh. Mr. Murray the publisher is to be congratulated on his idea of issuing them as single hand-maps instead of in atlas form—a practical convenience which must appeal to the student as well as to the teacher.

CHARTS.

TIDAL STREAMS, NORTH SEA. 12 Charts, published under superintendence of Rear-Admiral Sir W. J. L. Wharton, 1899. *Price* 5*s.*

Hydrographic Office, London.

The twelve charts contained in this volume shows the direction and rate of the tidal streams for every hour of the high tide at Dover. They have been compiled by Commander Cortland H. Simpson from observations by the late Captain F. W. Beechey, R.N., supplemented by British and Dutch naval surveys.

METEOROLOGICAL CHARTS OF THE SOUTHERN OCEAN, between the Cape of Good Hope and New Zealand. Published by the authority of the Meteorological Council, 1899. *Price* 12*s.*

Eyre and Spottiswoode, London.

The frequency and force of the winds are shown on twelve monthly maps, on which are small insets with the monthly air isotherms and the limits of fogs. On other sheets the currents are indicated by arrows varying in length in proportion to the strength of the current, and the surface temperature of the water by monthly isotherms.

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

A BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.

By Sir JOHN MURRAY, K.C.B., D.Sc., F.R.S., and FRED. P. PULLAR, Esq., F.R.G.S.

PART I. THE LOCHS OF THE TROSSACHS AND CALLANDER DISTRICT.

INTRODUCTION.

ABOUT forty years ago excellent bathymetrical charts of Loch Lomond and Loch Awe were published by the Hydrographic Department of the Admiralty, based on surveys undertaken by naval officers. Some of the general charts of the Scottish coasts published by the Admiralty also show a few soundings down the centres of the fresh-water lochs forming the Caledonian Canal, viz., Loch Ness, Loch Lochy, and Loch Oich, but the charts of Lochs Lomond and Awe represent the only systematic surveys of the fresh-water lochs in Scotland that existed previous to the year 1883.

About that time many scientific men in Scotland felt that a survey of these fresh-water lochs should be undertaken, which led to the Councils of the Royal Societies of London and Edinburgh bringing this subject under the notice of Her Majesty's Government, as shown in the following correspondence :—

I. The Secretary of the Royal Society of Edinburgh to the Secretary of H.M. Treasury.

ROYAL SOCIETY OF EDINBURGH,
11*th July* 1883.

SIR,—In consequence of the investigations now being carried on with reference to the physical and biological conditions of the Scottish fresh-water lakes, and

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also because of the importance, in certain branches of geological inquiry, of knowing the form of the basins occupied by these lakes, it has been prominently brought under the notice of the President and Council of this Society, that no bathymetrical survey of these lakes exists.

I have, therefore, been requested by the President and Council to ascertain from H.M. Government if there is any probability of this work being soon undertaken, and, at the same time, to state that it would be a great satisfaction to the President and Council to learn that instructions had been issued by the Lords Commissioners of H.M. Treasury to the Officers of the Ordnance Survey, or of the Hydrographic Department of the Admiralty, to undertake a survey of a few of these lakes similar to the excellent ones already made of Loch Lomond and Loch Awe, —say Lochs Morar, Maree, Lochy, Assynt, Shin, Tay, Ericht, Rannoch, Earn, Doon (in Ayrshire).—I am, etc., (signed) P. G. TAIT,

Secretary, Royal Society, Edinburgh.

II. The Secretary of H.M. Treasury to the Secretary of the Royal Society of Edinburgh.

TREASURY CHAMBERS,
17*th September* 1883.

SIR,—With reference to your letter of the 11th July last, and the reply from this Board, dated the 10th ultimo, relating to a proposal to execute a bathymetrical survey of certain fresh-water lakes in Scotland, I am directed by the Lords Commissioners of Her Majesty's Treasury to acquaint you that my Lords are informed that the nautical surveys of Loch Lomond and Loch Awe, referred to in your letter, were undertaken by naval officers in the interests of navigation, and that the same considerations do not apply to the other lochs, of which surveys are suggested in your letter.

My Lords are also informed that the proposed bathymetrical surveys do not come within the functions of the Survey Department of the Office of Works (late Ordnance Survey).

Under these circumstances, my Lords regret that they are unable to sanction the proposed surveys. I have the honour to be, etc.,

(signed) LEONARD COURTNEY.

III. Discussion in the House of Lords.

In March 1884, in reply to Lord Balfour of Burleigh in the House of Lords, Lord Sudeley said :—

In reply to the noble Lord, I have to state that the operations of the Ordnance Survey have been hitherto restricted to such portions of the ground in the vicinity of fresh-water pools, and inland sheets of water generally, as are above the lowest water levels. It is quite true, as the noble Lord has stated, that Loch Lomond and Loch Awe were surveyed, but that was undertaken by naval officers in the interests of navigation. The Government consider that a bathymetrical survey of all the lochs of Scotland would clearly be outside the function of the present Ordnance Survey of Scotland, which is already completed. Even if it were desirable, as the noble Viscount [Bury] has suggested, men would be taken off their work in England and the southern counties to carry this work out, and the general survey would be very much delayed. Such investigation would, no doubt, be most interesting from a scientific point of view in certain branches of geological inquiry to ascertain the forms of the basins occupied by the lakes. The Govern-

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ment will give the suggestions made by the noble Lord full consideration, and there will be no objection to lay the papers on the table.

IV. The Secretary of the Royal Society of London to the Secretary of H.M. Treasury.

THE ROYAL SOCIETY,
BURLINGTON HOUSE, *May* 2, 1884.

SIR,—The President and Council of the Royal Society have had under consideration a communication from the Royal Society of Edinburgh, from which it would appear that the Lords Commissioners of Her Majesty's Treasury have stated that they are unable to sanction a bathymetrical survey of certain of the Scottish lochs, as proposed by the Royal Society of Edinburgh.

I am directed by the President and Council of the Royal Society to assure my Lords that they fully share the regret expressed by the Royal Society of Edinburgh that my Lords should have arrived at such a decision.

Neither from a topographical nor from a geological point of view can the survey of the United Kingdom be considered complete so long as the depths of the several inland waters remain unknown, and the absence of adequate data, concerning not only the Scottish lochs but other large inland waters of the United Kingdom forms, and will continue to form, a very serious obstacle to geological research.

The President and Council do not desire to urge upon my Lords any elaborate surveys entailing a large expenditure. They have reason to believe that the most important objects of the proposed surveys would be gained if series of soundings were carried across the important lakes not yet bathymetrically surveyed, at moderate intervals in each case. The exact closeness of the lines of soundings, and the interval between each two soundings in each line must, in great measure, be determined at the time of observation according to the results which are from time to time obtained; but it has been suggested that lines of soundings at about a quarter of a mile interval, with soundings about one hundred yards apart, would probably be found generally useful.

The President and Council venture to remind my Lords that the carrying out of such a bathymetrical survey is much facilitated by the fact that the contours of the lakes in question have all been already accurately laid down, also that the inland waters of the continent have been carefully surveyed by the several European Governments, and that though in Scotland only Lochs Lomond and Awe have been surveyed (notwithstanding that some of the others are used for purposes of navigation) and the English lakes not at all, several of the Irish lakes were sounded by the Admiralty surveying officers in the years 1834-39 and in 1846.

The President and Council fully appreciate the difficulty which presents itself to my Lords in the facts that such bathymetrical surveys as those proposed do not fall within the province of the Survey Department of the Office of Works, and that, since the object sought is not one concerning navigation, they are foreign also to the duties of the Admiralty. The object, indeed, of the proposed survey may be most fitly spoken of as geological, but the Geological Survey has no means of carrying out such a work.

The President and Council would, however, venture to urge upon my Lords that the proposed survey, though of great scientific importance, is limited in scope and special in character, and so far not of a nature likely to establish an undesirable precedent, and they sincerely trust that my Lords may be led to reconsider their decision, and may see their way to make some arrangements by which a

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bathymetrical survey of the various inland waters of the United Kingdom not yet so surveyed may be speedily carried out.—I have, etc., (signed) M. FOSTER, *Sec. R.S.*

There was no practical outcome from this correspondence; the Government declined to undertake any of the proposed surveys.

In the year 1888 Mr. J. S. Grant-Wilson published in the *Scottish Geographical Magazine*[1] an account of Lochs Tay, Earn, Rannoch, and Tummel in Perthshire, with special reference to the glaciation of the district, and he gives small contoured maps of these lochs, in which the positions of some of the deeper soundings are laid down. This, together with the Admiralty charts of Lochs Lomond and Awe, appears to be all the published information with respect to the depth of the Scottish fresh-water lakes. Attempts have, however, frequently been made, by neighbouring proprietors and others, to ascertain the depth of many of these lochs. About twelve years ago Mr. J. Y. Buchanan recorded the great depth of 175 fathoms in Loch Morar, and this was subsequently confirmed through numerous soundings taken by Sir John Murray, who recorded a depth of 180 fathoms near the same place. Sir John Murray and Mr. J. Y. Buchanan likewise took many soundings in the lochs of the Caledonian Canal. Some of the English lakes have been surveyed within recent years by Dr. H. R. Mill, who gives an excellent account of his work in the *Geographical Journal* for 1895.[2]

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[1] Vol. iv. p. 251.

[2] The subject of Limnology has lately excited a great deal of interest, especially on the Continent and in America. The following are some of the more important publications:—

Forel, F. A. *Le Léman, monographie limnologique*, 2 vols. Lausanne, 1892 and 1895; and papers published in the *Arch. des Sci. phys. et nat.* Genève, 1886-1895.

Forbes, S. A. "On some Lake Superior Entomostraca," *U.S. Fish Comm. Report* for 1887, p. 701; also Reports of the Director of the Illinois State Laboratory of Natural History since 1894.

Belloc, E. Several papers published between 1890 and 1894, in the Reports of *Assn. franç. pour l'Avanc. des Sciences*, in the *Comptes rendus*, in the *Annuaire du Club Alpin français*, etc.

Zacharias, O. *Forschungsberichte aus der biologischen Station zu Plön*. Theil i.-iv. Berlin, 1893-96.

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In the present paper we propose to give the results of our numerous recent observations as to the depths in Lochs Katrine, Arklet, Achray, Vennachar, Drunkie, Lubnaig, Voil, and Doine, all of which belong to the catchment-basin of the river Teith, and have a special interest from being directly or indirectly connected with the excellent water-supply to the city of Glasgow.[1] It is true that at the present moment Loch Arklet belongs to the catchment-basin of Loch Lomond, but the Corporation of Glasgow has power to divert its waters into the catchment-basin of Loch Katrine.

Methods.

To undertake a survey of these fresh-water lochs with the ordinary hand-line would have occupied a very long time; in order to accelerate the work it was essential to procure a portable wire sounding-machine that could be used in small rowing boats. Such an instrument was exhibited by Dr. Ule at the Sixth International Geographical Congress in London in 1895. This apparatus was purchased, and with it numerous soundings were taken in Loch Morar, in Lochs Frisa, Ba, and Uisg in Mull, and also in Lochs Katrine, Lubnaig, and other lochs. After a few months' use, however, the machine—which was more or less of a toy—turned out untrustworthy, and was consequently discarded. Subsequently Mr. Pullar designed the sounding-apparatus shown in Fig. 1, which in his hands has worked admirably and accurately.

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[1] In the year 1855 the Corporation of Glasgow was empowered by Act of Parliament to raise Loch Katrine four feet above, and to draw it down three feet below, the previous summer level, thus giving a total available depth of seven feet for the supply of water to the city, the quantity of water to be drawn from the loch being restricted to fifty million gallons in twenty-four hours. For the purpose of providing compensation water to the riparian owners on the river Teith, power was also given to raise Loch Vennachar five feet nine inches above its previous summer level, and to draw it down six feet, and also to raise Loch Drunkie twenty-five feet. An aqueduct was built from the southern shore of Loch Katrine to Glasgow, eight feet wide and eight feet high throughout, with a semi-circular top, and having a fall towards Glasgow of ten inches per mile. At first only a portion of the available fifty million gallons per day was conveyed to Glasgow, but by the end of 1881 the whole of the works necessary to complete the original design were finished. In the year 1884 it was found necessary to provide a larger quantity of water in order to keep pace with the growth of the city, and it was then found that the roughness of the rock sides of the aqueduct had a very retarding influence upon the velocity of the water, and that the aqueduct could not be made to discharge more than forty-two million gallons per day. Power was subsequently obtained from Parliament to build a second aqueduct, to raise Loch Katrine an additional five feet, and to convert Loch Arklet, which flows into Loch Lomond, into a reservoir by raising it twenty-five feet in level. These works are now in progress, and when completed are estimated to give a supply of seventy-five millions of gallons of water per day to the city of Glasgow. Should a still greater supply be necessary in the future, it is believed this can be obtained by connecting Loch Doine with Loch Katrine by a tunnel through the intervening hills, and by constructing an embankment at the bottom of Loch Doine to raise the water-level thirty feet, and another at the bottom of Loch Voil to raise the water-level of that loch ten feet, and if still more water were wanted Loch Lubnaig could furnish it (see papers by James M. Gale, Esq., M. Inst. C. E., in the *Trans. Inst. Engineers in Scotland*, vols. vii., xii., xxvi., and xxxviii., and his Report on the proposed extension of the Glasgow Corporation Water Works, dated 17th May 1884).

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Description of the Pullar Sounding-Machine.

The sounding-machine (see Fig. 1) is constructed of steel cycle tubes, which are held in position by means of gun-metal brackets, and is divided into two sections in order to pack into as little space as possible for transport. The first section consists of a bracket, carrying two upright tubes, with an adjustable clamp (K), by means of which the machine is fixed to the gunwale of the boat. Over the ends of the two upright tubes, at the disconnecting joint (L), is slipped the second section of the machine, consisting of two horizontal tubes, to which the drum with the sounding wire, measuring pulley, indicating dials, grease-box, etc., are all fixed.

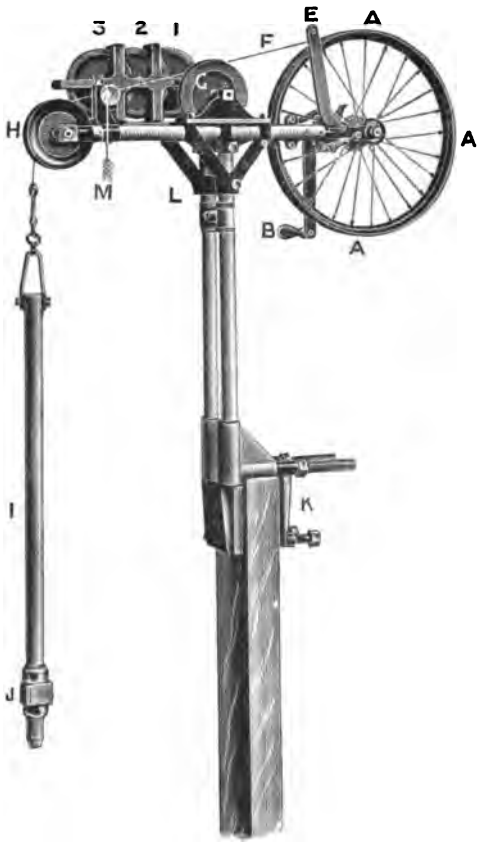

Fig. 1.—F. P. Pullar's Sounding-Machine.

The drum (A), which carries the wire, is a small suspension wheel, with steel U-shaped rim, tangent spokes, and gun-metal hub. The hub has cone bearings, which can be screwed up, so that any wear may be allowed for. The rim of the drum is capable of holding over one thousand feet of three-strand galvanised steel wire (F). On the hub of the drum is fixed a bronze pinion wheel, in gear with another pinion wheel fitted with a crank handle (B), by means of which the wire on the rim of the drum may be wound in, and on the other side of the hub is an adjustable band-brake (E) intended to regulate the speed of the wire when running out. There is also a stop for the purpose of preventing the weight from running out when the machine is not in use. The wire, after leaving the drum, takes a complete turn round a measuring pulley (G), then through a grease-box (M), and over a guide pulley (H), to the weight (I), which takes the form of a sounding-tube constructed to procure a sample of the deposit, with flap-valve (J) at the foot, the wire being attached to the weight by

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means of a splice and clip-hook. The measuring pulley has a circumference of nearly one foot (measured through the centre of the wire it is exactly one foot), so that for every foot of wire which runs out the measuring pulley makes one revolution. The motion of the measuring pulley is transmitted to a series of indicating dials (1, 2, and 3), one recording feet, another tens, and a third hundreds of feet. When the weight strikes the bottom the motion ceases, and the depth may be read off the indicating dials. The dials fitted to the present machine read only to a depth of 999 feet 6 inches, but by the addition of an extra dial greater depths could be sounded.

All the soundings recorded in this paper were taken from small rowing-boats, with the exception of a few obtained from Mr. Dunsmure's steam yacht on Loch Katrine, and they were all taken with Mr. Pullar's

(*Photo by Lady Murray.*)

FIG. 2.—Method of Sounding.

sounding-machine. It was usual to pass from side to side of a loch along definite lines, the length of the lines and the distances between them being ascertained from the six-inch Ordnance Survey maps, which were throughout used for plotting the positions of the soundings. Before making a section across a loch, the boatman was trained for some time to ascertain the distance covered in ten, fifteen, twenty, and fifty strokes. The position on the line of soundings was determined by reference to poles or other objects placed one behind the other on shore, and by the number of strokes between each position. When necessary the position was determined by means of a pocket sextant, and frequently the position of the soundings near the shore was ascertained by measurement with tape lines, or cords several hundred feet in length, stretched from the shore. In addition to the cross lines, soundings were usually taken in several positions between the lines. When any special feature was

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indicated by the soundings, a series was taken in a radial manner from a fixed point.

The level of the surfaces of the lochs was obtained by reference to the bench-marks along the shore, but as a rule no correction was made for the variations in the rise and fall of the water while the work was in progress. Information was collected when possible from local people as to the height of the water in the various lochs in the dry and wet months of the year.

The samples of bottom-deposits were carefully collected by means of the sounding-tube furnished with a flap-valve at its lower end (see Fig. 1), the colour and general appearance being noted, and the samples carefully preserved for future examination.

Serial temperatures were taken in each of the lochs by means of Negretti and Zambra's reversing thermometers, specially adapted for use on the wire-rope of the sounding-machine; observations at the surface of the lochs, and in the streams feeding the lochs, were frequently made as opportunity offered. The pelagic fauna and flora of these lakes were examined by means of fine silk tow-nets, which were dragged through the water at different depths, and the colour and transparency of the water were frequently tested by the submergence of coloured discs.

After the completion of the survey of a particular lake, and when all the soundings had been plotted on the six-inch Ordnance Survey maps, contour-lines of depth were drawn at definite intervals, and the areas between the consecutive contours were measured by the planimeter, from which the cubic contents and the mean depth of each loch were calculated. The drainage areas of the various lochs (as shown on Map I.) were marked off on the one-inch Ordnance Survey maps, and the areas between the consecutive contour-lines of height were measured by the planimeter, from which the bulk and the mean height of the land above the level of the lochs were calculated.

Maps and Illustrations.

This paper is illustrated by seven coloured maps. The first three are intended to show the general physical features of the district in which the lochs, treated of in this paper, are situated, and are drawn to a scale of two miles to the inch.

Plate I. shows the orography of the district, the height of the land being indicated by different shades of brown, and the depth of the lochs in fathoms by different shades of blue, and the drainage areas of the various lochs are outlined by a distinctive coloured line. It will be observed that the drainage areas form together one compact area, and indeed it may be said that (excluding in the meantime Loch Arklet) they are in reality one united drainage system, since Lochs Doine, Voil, and Lubnaig drain into the river Leny, and Lochs Katrine, Achray, Drunkie, and Vennachar drain into the river Teith, which two rivers join above Callander, and flow onwards until they join the river Forth at Stirling, and ultimately empty themselves into the Firth of Forth.

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Plate II. shows the surface geology of the district in various colours, and has been prepared from unpublished material collected during the progress of the Geological Survey of Scotland, revised by Messrs. Peach and Horne, and now published by permission of Sir Archibald Geikie, the Director-General of the Geological Survey of the United Kingdom. A discussion of the geology and glaciation of this district, and of the relation of the depths of the lochs to the surrounding geological features of the country, will be found in the valuable and important geological notes contributed by Messrs. Peach and Horne appended to this paper.

Plate III. shows the mean annual rainfall of the district in different shades of blue, the mean rainfall at the various observing-stations being given in heavy black figures. We are indebted to Dr. Alexander Buchan, F.R.S., for information which has enabled us to prepare this map.

The remaining four maps show the details regarding each of the lochs under consideration on a larger scale (3 inches to the mile, 1 : 21,120), on which the majority of the soundings taken during the survey are given in feet, the intervals between the contour-lines of depth being indicated by different shades of blue, and the intervals between the contour-lines of height of the neighbouring country by shades of brown.

Plate IV. shows Loch Katrine and Loch Arklet, the contour-lines of depth being drawn in Loch Arklet at 25 and 50 feet, and in Loch Katrine at 50, 100, 200, 300, and 400 feet.

Plate V. shows Loch Achray, Loch Vennachar, and Loch Drunkie, the contour-lines of depth being drawn in Loch Achray at 25 and 50 feet, the area deeper than 90 feet being indicated by a dotted line, in Loch Vennachar at 25, 50, and 100 feet, and in Loch Drunkie only at 50 feet.

Plate VI. shows Loch Lubnaig, the contour-lines of depth being drawn at 10, 25, 50, 75, and 100 feet.

Plate VII. shows Loch Doine and Loch Voil, the contour-lines of depth being drawn in Loch Doine at 25 and 50 feet, and in Loch Voil at 25, 50, and 75 feet, the area deeper than 90 feet being indicated by a dotted line.

We tender our thanks to J. G. Bartholomew, Esq., F.R.G.S., for the care with which he has supervised the production of these maps, and for valuable advice and suggestions during the progress of the work.

In addition to the maps there are eleven woodcuts in the text, illustrating the character of the scenery in the vicinity of the lochs, the sounding-machine, etc.

Depths of the Lochs.

Loch Katrine.—Loch Katrine is one of the best known and most beautiful of the Scottish lochs. The celebrated woodland scenery of the Trossachs and Ellen's Isle is situated at its south-eastern end, while splendid moorland scenery prevails at the north-western end. It has a total length of about eight miles, with a maximum width of almost exactly one mile between the mouths of Letter Burn and Strone Burn on the northern shore to a small bay on the opposite shore. The mean

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breadth, obtained by dividing the area of the loch by its length, is 0·6 mile, or 1056 yards, being 7½ per cent. of the length.

The waters of the loch cover an area of 3059 acres (or 4¾ square miles), and it drains an area about eight times greater, or about 24,900 acres (nearly 37½ square miles).[1] The total number of soundings taken in Loch Katrine was 775, an average of 163 per square mile, and the average depth of these was 142½ feet, the greatest depth observed being 495 feet (82½ fathoms).[2] The positions of the majority of the soundings are shown on Map IV.

The bulk of water contained in the loch is estimated at 27,274,000,000 cubic feet, or about one-fifth of a cubic mile, and the mean depth

(*Photo by J. Valentine.*)

FIG. 3.—Loch Katrine and Ellen's Isle.

(supposing the loch to be of uniform depth over its present area) at 199 feet (33 fathoms), the mean depth being over 40 per cent. of the maximum depth. The length of the loch is 85 times the maximum depth, and 211 times the mean depth.

The surface of the loch is, according to the Ordnance Survey maps, at an elevation of 364 feet above sea-level, so that our survey shows

[1] When the waters of Loch Arklet are diverted into Loch Katrine this drainage area will, of course, be extended.

[2] As long ago as September 1812 and September 1814 Mr. James Jardine, C.E., recorded observations on the depth and temperature of Loch Katrine (see Buchan, *Proc. Roy. Soc. Edin.*, vol. vii. p. 791. 1872). The maximum depth recorded by him is 480 feet (80 fathoms), whereas, as stated above, we found a depth of 495 feet. His temperature observations are given in the table of serial temperatures, and discussed along with the recent observations. We believe that Mr. J. Y. Buchanan took soundings and temperatures in Loch Katrine some years ago, but, as far as we are aware, they were never published, and are therefore not available for discussion (see also Art. "Lake" in *Encycl. Brit.*, 9th ed.).

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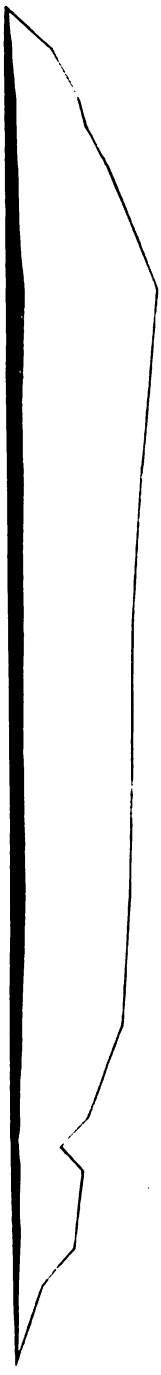

FIG. 4.—Longitudinal section of Loch Katrine, along the axis of maximum depth. The black portion shows the true slopes; the outline shows the slopes exaggerated ten times.

that a considerable portion of the bottom of the loch (equal to about 645 acres, or over one square mile) lies below sea-level, the deepest part being 131 feet (or 22 fathoms) below the level of the sea. The area below the level of the sea is indicated by a red line on Map IV. In this respect Loch Katrine differs from the other lochs referred to in this paper, for in none of them is the depth sufficiently great to bring any portion of their bottoms below the level of the sea.

The soundings show that Loch Katrine practically forms a single basin, not being divided, like Loch Lomond and Loch Lubnaig, for instance, into separate basins by any important ridges or rises on the bottom. The deepest part is in the centre of the loch, a long narrow depression, with depths exceeding 400 feet, extending for over four miles from opposite Coilachra to opposite Ruinn Dubh-aird, with a maximum width of over a quarter of a mile; this 400-feet depression has an area of about 515 acres, or 17 per cent. of the entire superficial area of the loch. The deepest sounding (495 feet) is situated at the very eastern extremity of the 400-feet depression.

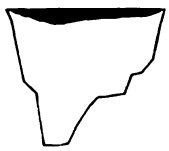

FIG. 5.—Cross section of Loch Katrine. The black portion shows the true slopes; the outline shows the slopes exaggerated ten times.

The 300-feet depression is over five miles in length, with a maximum breadth of one-third of a mile; it extends from off Coilachra to near Ellen's Isle. The area enclosed between the 300-feet and 400-feet contour-lines is about 415 acres, or 13 per cent. of the entire area of the loch.

The 200-feet depression is 5½ miles in length and half a mile in maximum breadth, extending from south of Ellen's Isle to near Black Island, where it is separated (by a sounding of 198 feet) from a small isolated area, lying between Coilachra and Black Island, one-third of a mile in length by nearly one-eighth of a mile broad. The area between the 200- and 300-feet contours is about 510 acres, or 17 per cent. of the area of the loch.

There are two 100-feet depressions, the principal one (six miles in length) stretching from close to Ellen's Isle to Black Island, the other extending from Black Island towards the point called Rudha nam Moine, with a total length of over half a mile. The area enclosed between the 100- and

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200-feet contours is about 670 acres or 22 per cent. of the area of the loch.

The 50-feet line follows pretty closely the contour of the loch, from Rudha nam Moine into the eastern arms of the loch at the Trossachs, running outside of Black Island, Ellen's Isle, and the small islands near the shore all round, with a small isolated patch at the junction of the Trossachs arm with the arm leading to Achray Water; it encloses a small shallow, with a beacon on it, opposite the entrance of the Glasahoile. The area between the 50- and 100-feet contours is about 400 acres, or 13 per cent. of the area of the loch, while the area between the coast-line and the 50-feet contour is nearly 550 acres, or 18 per cent. of the area of the loch, so that 82 per cent. of the floor of the loch is covered by over 50 feet of water.

Loch Arklet.—At the present time Loch Arklet drains into Loch Lomond, but the corporation of the city of Glasgow have power, by the

(*Photo by G. W. Wilson.*)

FIG. 6.—Loch Arklet, looking west.

erection of a dam at its west end, to divert the waters into the catchment-basin of Loch Katrine, in order to increase the supply of water to the city. The surface of this little moorland loch is, according to the Ordnance Survey maps, 455 feet above sea-level. It has a total length of over a mile, with a maximum width near the east end of nearly half a mile. The mean breadth is about one-third of a mile, or 587 yards, being 33 per cent. of the length. Its waters cover an area of about 210 acres (0·3 square mile), and it drains an area about sixteen times greater, or about 3400 acres (5⅓ square miles). The number of soundings taken in Loch Arklet (see Map IV.) was 135, the average depth of these being

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21 feet, and the greatest depth observed being 67 feet (11 fathoms). The mass of water in the loch is estimated at 222,000,000 cubic feet, and the mean depth at 24 feet, or 36 per cent. of the maximum depth. The length of the loch is 79 times the maximum depth, and 218 times the mean depth.

The wide eastern portion of Loch Arklet is shallower than the narrower western portion. The 50-feet depression extends little more than half way towards the eastern end of the loch, and is slightly under half a mile in length, the greatest depth (67 feet) being approximately near the centre of the depression, and nearer the western than the eastern end. The area over 50 feet in depth is estimated at about 19 acres, or 9 per cent. of the area of the loch, while the area between the 50-feet line and the shore is about 191 acres, or 91 per cent. of the entire superficial area.

Two small islands appear on the chart in the shallower part of the loch towards the north-eastern end.

Loch Achray.—This pretty little lake is situated at the entrance to the Trossachs, and immediately before the windows of the Trossachs

(*Photo by J. Valentine.*)

FIG. 7.—Loch Achray, looking west towards Ben Venue.

Hotel. Loch Achray, the surface of which is, according to the Ordnance Survey maps, 276 feet above sea-level, has a total length of about one and a quarter miles, with a maximum width of nearly one-third of a mile. The mean breadth is about a quarter of a mile, or 458 yards, being nearly 21 per cent. of the length. Its waters cover an area of about 205 acres (one-third of a square mile), and the area draining into it is twenty-two times greater, or about 4500 acres (7 square miles). The

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number of soundings taken in Loch Achray (see Map V.) was 171, and the average depth of these was 36½ feet, the maximum depth recorded being 97 feet (16 fathoms). The bulk of water contained in the loch is estimated at 321,000,000 cubic feet, and the mean depth at 36 feet (6 fathoms), or 37 per cent. of the maximum depth. The length of the loch is 68 times the maximum depth, and 183 times the mean depth.

The 50-feet depression is over two-thirds of a mile in extreme length, with a maximum width of about one-fifth of a mile, lying uniformly near the centre of the loch, and covers an area of about 64 acres, or 31 per cent. of the superficies of the loch. Within this area there is a depression occupying about 32 acres where the depths exceed 90 feet, the greatest registered depth (97 feet) being recorded in two places approximately in the centre of the loch. At the west end of the loch, not far from the hotel pier, a detached sounding of 50 feet is recorded; off the mouth of the Achray Water there are some shallow patches, and a shallow in the centre of the loch towards the west end, on which there are two to three feet of water, is marked by a beacon. The area, less than 50 feet in depth, is estimated at about 141 acres, or 69 per cent. of the total area of the loch. The eastern end of the loch is relatively shallow; at one place there is a depression with 27 feet surrounded by shallower water, and at another place there is what appears to be a submerged crannog covered by only one or two feet of water.

Loch Vennachar.—Loch Vennachar, the surface of which is, according to the Ordnance Survey maps, 270 feet above sea-level, has a total length

(*Photo by G. W. Wilson.*)

FIG. 8.—Loch Vennachar, looking south-west.

of about four miles, with a maximum width of less than three-quarters of a mile. The mean breadth is about two-fifths of a mile, or 704 yards, being 10 per cent. of the length. Its waters cover an area of about 1030 acres (or over one and a half square miles), and it drains an area nearly eighteen times greater, or about 18,300 acres (over 28½ square miles). The total number of soundings taken in Loch Vennachar (see Map V.) was 423, an average of 263 per square mile, the average depth of these being 41 feet,

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and the greatest depth observed being 111 feet (18½ fathoms), so that it may be regarded as a relatively shallow loch. The bulk of water contained in the loch is estimated at 1,903,000,000 cubic feet, and the mean depth at 42½ feet (7 fathoms), being 38 per cent. of the maximum depth. The length of the loch is 190 times the maximum depth, and 498 times the mean depth.

It will be observed from an examination of the map that the loch is deeper in the eastern than in the western portion, the western end being shallow and covered with weeds, so that one must proceed nearly a mile from the west end of the loch before encountering depths of 50 feet, and this is merely a small patch separated from the principal 50-feet depression by a distance of nearly two-thirds of a mile. In August the water in the loch is at its lowest, and the weeds at the west end most abundant. The principal 50-feet depression is about two miles in length, with a mean breadth of about one-third of a mile and a maximum breadth of nearly half a mile. It includes two 100-feet depressions: the first one is very irregular in shape, situated approximately in the centre of the loch, and contains the greatest observed length (111 feet), which lies towards the northern shore; the second one occupies the central portion of the large 50-feet depression, the greatest depth observed therein being 106 feet. Towards the eastern end of the large 50-feet depression is a small shallow patch in the centre of the loch opposite Portnellan, in which a depth of 36 feet was found.

At the extreme eastern end are situated the sluices and weir, over which the compensation water passes into the river Teith; at some distance from the sluices the depth of water flowing over a weir is recorded twice a day.

The area between the shore and the 50-feet contour is estimated at about 635 acres, or 62 per cent. of the entire superficial area of the loch, while the area between the 50- and 100-feet lines is estimated at about 324 acres, or 31 per cent., and the area with depths over 100 feet is estimated at about 71 acres, or 7 per cent. of the area of the loch.

Loch Drunkie.—This picturesque and irregular Highland loch is shut in on all sides by high hills, is difficult of access, and rarely visited. The surface of the loch, according to the Ordnance Survey maps, is 416 feet above the level of the sea, but it was raised 25 feet in connection with the water-supply to the city of Glasgow, with the view of furnishing compensation water to the river Teith. The soundings shown on the map give the depth of the loch in April 1899.

Loch Drunkie is remarkable in many respects. It is the smallest of the five lochs in the Loch Katrine district, but deeper than the larger Loch Arklet situated at a similar high elevation, and quite as deep as the neighbouring Loch Achray situated at a lower elevation. In form it is peculiar, consisting of a quadrangular portion throwing out three arms of various sizes in different directions. The largest arm runs in a north-easterly direction, the extremity approaching within a quarter of a mile of the southern shores of Loch Vennachar; this arm contains the greatest depths observed in the loch, and near its extremity the Ordnance Survey map indicates a small island which was not seen. The second

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arm in point of size runs directly west, and contains a maximum depth of 80 feet. The smallest arm runs in a south-westerly direction, deepening gradually though irregularly from 6 feet at the extremity to 15 feet near the junction with the quadrangular body of the loch.

The maximum length of the loch (between the extremities of the north-eastern and south-western arms) is over one mile; from the extremity of the western arm to the opposite (eastern) shore of the loch is a little less. The maximum width of the quadrangular body of the loch is over a quarter of a mile. The mean breadth is 0·21 mile, being 21 per cent. of the length. The waters of the loch cover an area of about 138 acres (0·22 square mile), and drains an area ten times greater, or over 1400 acres (2·2 square miles). The number of soundings taken in Loch Drunkie (see Map V.) was 155, the average depth of these being 38½ feet, the greatest depth observed (exactly the same as in the case of Loch Achray) being 97 feet (16 fathoms). The bulk of water contained in the loch is estimated at 217,000,000 cubic feet, and the mean depth at 36 feet (or 6 fathoms), being 37 per cent. of the maximum depth. The length of the loch is 54 times the maximum depth, and 147 times the mean depth.

There are two depressions with depths over 50 feet: one at the extremity of the western arm, about a quarter of a mile in length, and the other filling up the greater part of the body of the loch, and extending some distance up the north-eastern arm, being over one-third of a mile in length and about one-quarter of a mile in maximum width. The area over 50 feet in depth is estimated at 43 acres, or 31 per cent. of the total area of the loch, while the area between the shore and the 50-feet contour is estimated at 95 acres, or 69 per cent. of the area of the loch.

Lochs Voil and Doine.—These two lochs, the surfaces of which, according to the Ordnance Survey maps, are situated at an elevation of 414 feet above sea-level, formed at no very distant date a continuous loch, which has been divided into two portions principally by the deposition of material brought down Monachyle Glen by the river; this is supported by the fact that deep water extends close up to the dividing promontory of land on both sides. The former continuous loch must have been over four and a half miles in length. As the level of these two lochs is 50 feet higher than the level of Loch Katrine, it has been suggested by Mr. Gale that the water-supply to the city of Glasgow could if necessary be increased by connecting these lochs to Loch Katrine by a conduit through the intervening hills.

Loch Voil.—Loch Voil has a total length of over 3½ miles, with a maximum width (near the western end) of about one-third of a mile. The mean breadth is about a quarter of a mile, or 422 yards, being 7 per cent. of the length. The waters of Loch Voil cover an area of about 561 acres (0·88 square mile), and those of Loch Doine about 135 acres (0·21 square mile), or together over one square mile, while they drain an area thirty-five times greater, or about 24,600 acres (nearly 38½ square miles).

The total number of soundings taken in Loch Voil (see Map VII.) is 279,

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the average depth of these being 39½ feet, and the greatest depth 98 feet (or 16⅓ fathoms). The bulk of water contained in the loch is estimated at 1,000,000,000 cubic feet, and the mean depth at 41 feet (or nearly 7 fathoms), being 42 per cent. of the maximum depth. The length of the loch is 189 times the maximum depth, and 451 times the mean depth.

Loch Voil becomes narrower and shallower towards the eastern end; one must proceed about a mile and a half (or over one-third of the length of the loch) from the eastern end before encountering depths of 50 feet, while deeper water is found towards the western end. The 50-feet depression extends from quite close to the western end for a distance of two miles towards the eastern end of the loch, with a maximum width

(*Photo by J. Valentine.*)

FIG. 9.—Lochs Voil and Doine, looking west from Rob Roy's grave, Balquhidder.

of about a quarter of a mile. Towards the western end of the loch is a considerable area (over half a mile in length by a sixth of a mile in maximum breadth) having depths greater than 90 feet. In this all the deepest soundings are situated (the greatest depth, 98 feet, having been observed in two places). From this depression the bottom of the loch apparently rises very gradually towards the eastern end.

The area over 50 feet in depth is estimated at about 230 acres, or 41 per cent. of the entire area of the loch, while the area between the shore and the 50-feet line is estimated at about 331 acres, or 59 per cent. of the total extent of the loch.

Loch Doine.—Loch Doine has a total length of nearly one mile, with a maximum width of over a quarter of a mile; the mean breadth is

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about 0·21 mile, or 370 yards, being 21 per cent. of the length. The total number of soundings taken in Loch Doine (see Map VII.) was 90, the average depth of these being 34¾ feet, the greatest depth being 65 feet (11 fathoms). The bulk of water contained in the loch is estimated at 196,000,000 cubic feet, and the mean depth at 33 feet (5½ fathoms). The length of the loch is 81 times the maximum depth, and 160 times the mean depth.

In Loch Doine the deeper water occupies approximately the centre of the loch, the deepest soundings (65 feet) being found, however, nearer the eastern than the western end of the loch. The 50-feet depression covers over one-third of the area of the loch, being about three-quarters of a mile in length with a maximum width of over one-eighth of a mile. It seems doubtful whether this 50-feet depression is not really separated into a larger and a smaller portion, for the narrow neck shown on the map is founded upon a single sounding of exactly 50 feet. The greatest depth, 65 feet, was observed in several spots situated towards the eastern end of the loch. The area with depths over 50 feet is estimated at 47 acres, or 35 per cent. of the entire area of the loch, while the area with depths less than 50 feet is estimated at 88 acres, or 65 per cent. of the area of the loch.

Loch Lubnaig.—The outflow from Lochs Doine and Voil passes by the river Balvag, five miles in length, into Loch Lubnaig, the surface of whose waters is, according to the Ordnance Survey maps, 405 feet above sea-level, or nine feet lower than that of the other two lochs. A consideration of the intervening ground indicates that in post-glacial times these three lochs formed one single sheet of water.

Loch Lubnaig has a total length of nearly four miles, following approximately a line drawn down the centre of the loch, with a maximum width of about two-fifths of a mile. The mean breadth is nearly a quarter of a mile, or 422 yards, being 6 per cent. of the length. Its waters cover an area of about 614 acres (or nearly one square mile), and it drains an area 36½ times greater, or about 22,400 acres (nearly 35 square miles). The total number of soundings taken in Loch Lubnaig (see Map VI.) was 394, the average depth of these being 20½ feet, and the greatest depth observed 146 feet (24⅓ fathoms). The bulk of water contained in the loch is estimated at 1,144,000,000 cubic feet, and the mean depth at 42¾ feet (or 7 fathoms), being 29 per cent. of the maximum depth. The length of the loch is 145 times the maximum depth, and 493 times the mean depth.

Loch Lubnaig differs from the other lochs in the neighbourhood in that it does not constitute a single basin. The bottom is apparently very irregular; the contour-lines of depth do not follow the contour of the loch, hollows and ridges alternate with each other, and in some places comparatively deep water is found close to the shore, while in other places shallow water extends a considerable distance from shore. The loch is also, comparatively speaking, very narrow and shallow considering its size, nearly two-thirds of the area being under 50 feet in depth. The loch may be conveniently divided into two halves, defined by the central constriction in the outline of the loch at the entrance of

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the Ardchullarie Burn, where the bottom shallows and separates the two principal deep depressions; the northern half trends in a north-west and south-east direction, while the southern half trends almost directly north and south.

There are two depressions in which the depth exceeds 100 feet, with an isolated sounding of 106 feet between them. The larger depression is contained in the southern half of the loch, and is over half a mile in length with a maximum width of about one-sixth of a mile; the greatest depth in this depression is 118 feet. The smaller but deeper depression is situated at the base of the northern half of the loch, occupying a central position, and is over a quarter of a mile in

(*Photo by G. W. Wilson.*)

FIG. 10.—Loch Lubnaig, looking north.

length, with a maximum width of about one-sixth of a mile. The deepest sounding in the loch (146 feet) is centrally placed in this depression, lying north-westward of the point where the Ardchullarie Burn enters the loch. The area over 100 feet in depth is estimated at about 55 acres, or 9 per cent. of the entire area of the loch.

There are three depressions in which the depth exceeds 50 feet. The largest is contained in the southern half of the loch, and is over one and a half miles in length, with a maximum width of over a quarter of a mile. The second in point of size is centrally placed, and is over half a mile in length, with a maximum width of over a quarter of a mile. The third and smallest (and also the shallowest, the deepest sounding in it being 62 feet) is situated near the northern end of the loch, and is little more than a quarter of a mile in length and about one-eighth of a

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mile in greatest width. At the upper end of the loch, where the river Balvag enters, there is a long spit formed of detritus brought down by the river, and this end of the loch for a distance of three-quarters of a mile is very shallow, while at the lower end the 50-feet contour is found within two hundred yards of the outlet. The area between the 50-feet and 100-feet contours is estimated at about 162 acres, or 26 per cent. of the total area of the loch, while the area with depths under 50 feet is estimated at about 397 acres, or 65 per cent. of the area of the loch.

When the loch was visited on April 6, 1899, it appeared from marks on the shore that the water had lately been four feet ten inches higher than at that time, and it has been known to have been twelve or eighteen inches lower, so that the rise and fall is about six feet in all. On one occasion a disc was visible down to a depth of 17½ feet, and on another down to 20½ feet.

On the western shore, between 1¼ and 1½ miles from the southern end of the loch, there is a remarkable sandy spit, which stretches out towards the centre of the loch, the origin of which appears to us somewhat puzzling (see the Geological Notes by Messrs. Peach and Horne).

The details regarding the different lochs have been collected together in the annexed table (p. 213) for convenience of reference and comparison.

Deposits.

As a general rule the materials forming the deposits in these fresh-water lochs become finer-grained the farther from the shore and the deeper the water. Off the mouths of rivers and burns there is frequently a considerable accumulation of gravel and fine sand, extending for some distance into the lake and occasionally reaching rather deep water. Large stones, gravel, and sand are usually found all round the shores within the limits of wave action. The height and length of the waves, and the depth to which wave action extends, depend on the size and depth of the loch.

The central parts of the lochs are occupied by a fine impalpable mud, which is found in its most characteristic form in the greater depths far from shore; it is usually of a light- or dark-brown colour, and sometimes there are indications of different-coloured layers. The usual mineral species are quartz, felspars, black and white mica, amphibole, pyroxene, magnetite, garnets, etc. Chemical analysis showed that these fine muds contained no appreciable calcareous matter, but traces of sulphuretted hydrogen were always present. The loss on ignition after drying at 90° C., due to organic matter and combined water, varied from 13 to 26 per cent. Diatoms were observed in nearly all the samples, and vegetable fibre was usually present in greater or less abundance.

The samples from the deepest part of Loch Katrine were brownish, fine-grained, homogeneous muds, with glittering mica-flakes, consisting principally (50 to 70 per cent.) of angular mineral particles exceeding 0·05 mm. in diameter, the mean diameter being about 0·15 mm., with

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LOCH	Elevation of Surface above the Sea.	Number of Soundings.	Length.	Breadth, Miles.		Mean breadth per cent. of Length.	Depth.			Ratio of Depth to Length.		Volume, Million Cubic Feet.	Area of Loch.	Drainage Area.	
							Feet.								
	Feet.		Miles.	Max.	Mean.		Max.	Mean.	Mean per cent. of Max.	Max.	Mean.		Square Miles.	Total in Square Miles.	Ratio to Area of Loch.
Katrine, . .	364	775	8·00	1·00	0·60	7·5	495	199·189	40·4	85	211	27,274	4·78	37·42	7·83
Arklet, . .	455	135	1·00	0·50	0·33	33·3	67	24·190	36·1	79	218	222	0·33	5·33	16·15
Achray, . .	276	171	1·25	0·33	0·26	20·8	97	36·009	37·1	68	183	321	0·32	7·06	22·06
Vennachar, .	270	423	4·00	0·75	0·40	10·0	111	42·410	38·2	190	498	1,903	1·61	28·65	17·80
Drunkie, . .	416	155	1·00	0·25	0·21	21·0	97	36·050	37·1	54	147	217	0·22	2·20	10·00
Voil, . . .	414	279	3·50	0·33	0·24	6·9	98	40·936	41·8	189	451	1,000	0·88	38·47	35·29
Doine, . . .	414	90	1·00	0·25	0·21	21·0	65	33·130	51·0	81	160	196	0·21		
Lubnaig, . .	405	394	4·00	0·40	0·24	6·0	146	42·773	29·3	145	493	1,144	0·96	34·97	36·43
		2422										32,277	9·31	154·10	16·55

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clayey and vegetable matter, and many minute mineral particles less than 0·05 mm. in diameter. A few Diatoms were observed, and one sample, after drying at 90° C., gave 19·91 per cent. loss on ignition.

The mud from the deepest part of Loch Achray was of a grey-brown colour, containing much vegetable and clayey matter, the mineral particles exceeding 0·05 mm. in diameter making up probably 30 or 40 per cent. of the whole deposit. Some fine Diatoms were observed, and the loss on ignition, after drying at 90° C., amounted to 12·84 per cent.

The mud from a depth of 102 feet in Loch Vennachar was yellowish-brown in colour, containing about 20 per cent. of mineral particles, with a mean diameter of 0·1 mm., but principally made up of amorphous clayey matter with vegetable matter, and many minute mineral particles less than 0·05 mm. in diameter. There were a few Diatoms; the loss on ignition, after drying at 90° C., amounted to 14 per cent.

The mud from the deeper part of Loch Drunkie was of a dirty brown colour, containing 10 to 20 per cent. of mineral particles with a mean diameter of 0·1 mm., but consisting principally of amorphous clayey matter, with many small mineral particles, and vegetable matter. A few Diatoms were observed. The loss on ignition, after drying at 90° C., amounted to 26·38 per cent.

The deposit from the deeper parts of Loch Arklet was similar to that from Loch Drunkie, with even a larger quantity of vegetable matter.

The mud from the deeper parts of Lochs Doine and Voil was of a brown colour, with 30 to 40 per cent. of mineral particles, and clayey and vegetable matter, and a few Diatoms. A sample from a depth of 80 feet in Loch Voil, after drying at 90° C., gave 22·74 per cent. loss on ignition.

The material from a depth of 136 feet in Loch Lubnaig was a brown impalpable mud, with 30 to 40 per cent. of mineral particles, much clayey and vegetable matter, and a few Diatoms. The loss on ignition, after drying at 90° C., amounted in one sample to 16·29 per cent., and in another sample to 15·76 per cent.

Temperature Observations.

During the various visits to the different lochs, many observations were made on the temperature of the water, both on the surface and at intervals below the surface, down to the bottom. All the serial temperatures taken by us have been collected together in the following Table,[1] and, in order to make the record more complete, the temperatures taken by Jardine in 1812 and 1814 in Loch Katrine are given in the first two columns :—

[1] Temperature observations in the surface-waters of some of the lochs under consideration have been taken by Mr. Thomas Scott, and the results published in the *Annual Reports of the Fishery Board for Scotland.*

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Depth in Fathoms.	LOCH KATRINE.							LOCH ARKLET.	LOCH ACHRAY.	LOCH DRUNKIE.	LOCH VENNACHAR.		LOCH DOINE.		LOCH VOIL.			LOCH LUBNAIG.
	Jardine. 7th Sept. 1812.	Jardine. 3rd Sept. 1814.	6th June 1897.	9th June 1897.	28th Nov. 1897.	9th June 1898.	15th Apr. 1899.	11th June 1897.	12th June 1897.	12th June 1897.	10th June 1897.	11th Apr. 1899.	7th July 1897.	10th Apr. 1899.	7th July 1897.	7th July 1897.	10th Apr. 1899.	8th Apr. 1899.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Surface	57·9	56·8	55·9	...	47·4	55·0	41·2	55·4	57·5	57·0	55·8	42·6	54·0	42·0 42·6	56·0	55·0	42·0	42·0
1	...	...	...	...	47·4	...	41·2	...	...	...	...	...	...	42 6	...	...	...	...
2	...	...	...	...	...	...	...	...	...	...	...	42·5	...	...	...	...	...	...
3	...	...	...	...	47·4	...	...	...	...	...	...	...	...	...	55·3	...	...	...
5	...	56·7	48·4	52·0	47·4	54·0	42·0	54·4	53·5	52·6	53·3	42·5	53·4	42·1	...	54·0	42·1	42·7
8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	55·3	...	...	...
10	50·9	49·6	44·0	...	47·3	47·8	41·9	...	...	...	48·2	42·5	52·1	42·0 41·8	...	...	42·0	41·9
15	...	45·5	...	...	47·4	...	...	...	...	...	47·2	42·7	...	...	...	...	...	42·6
16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	54·5	...	...
18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	42·6
20	43·5	44·4	42·0	...	47·4	44·0	42·0	...	...	...	...	...	...	...	...	...	...	41·8
23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	41·8
25	...	43·3	...	...	46·8	...												
30	...	42·3	42·5	...	46·0	43·5												
35	41·5	...	...	...	43·5	...												
40	...	...	41·5	...	43·8	42·6												
45	...	...	...	...	42·9	...												
50	41·5	...	42·2	...	43·2	...												
55	...	...	...	...	42·5	...												
60	41·5	...	41·5	...	...	...												
66	...	...	...	...	...	42·8												
76	...	...	...	...	...	42·0												
80	41 4	41·7	...	...	43·0	...												
82½	...	...	...	...	43·8	...												

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Loch Katrine.—The surface temperatures taken in Loch Katrine during the seven days from June 5th to 11th, 1897, are extremely interesting, as illustrating the effect of the wind. The range of temperature during this time was 12½°, from 45·3° to 57·8°, the highest reading being observed at Trossachs pier on the evening of June 5th, and the lowest at the same place on the evening of June 9th. This was evidently the result of a strong east wind, which commenced to blow on the 6th, and continued from the same direction till the 9th, blowing the warm surface-waters before it from the east towards the west end of the loch, while colder water from below was drawn up to the surface at the east end of the loch to take its place. The gradual cooling of the water at the east end of the loch is well shown by the temperatures

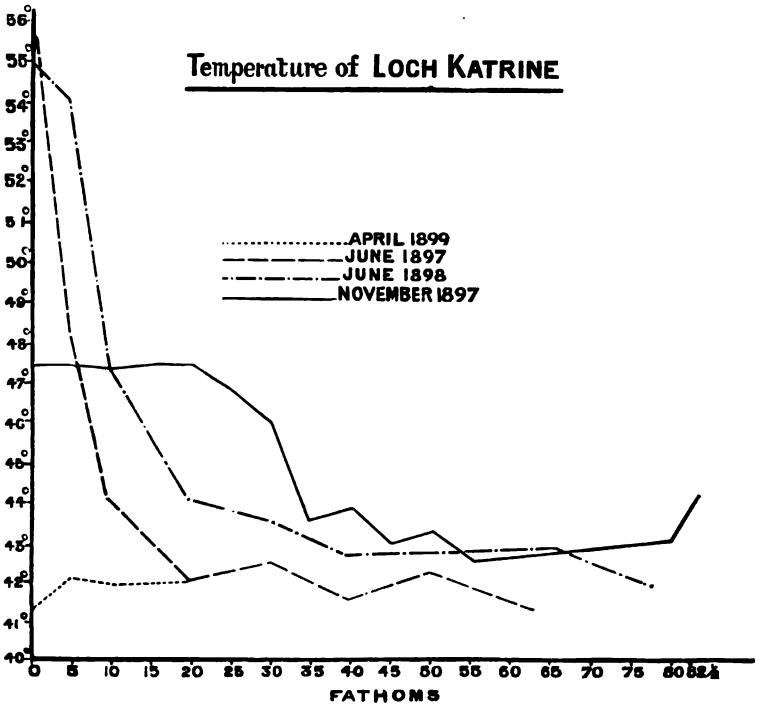

FIG. 11.—Curves of temperature in Loch Katrine.

taken at Trossachs pier from day to day: thus at 6.30 P.M. on June 5th the temperature was 57·8°, at 11.30 A.M. on the 6th it was 56·2°, and at 4 P.M. 55·3°; at 7 A.M. on the 7th it was 49·2°; at 10.30 A.M. on the 8th it was 46·3°; and at 7.15 P.M. on the 9th it was 45·3°. By 9.30 A.M. on the 11th it had risen again to 50·1°. The effect of the wind was also shown by a series of surface-temperatures taken from the steamer on its way from Stronachlachar pier to the Trossachs pier on the evening of June 9th: thus at Stronachlachar the temperature was 52·6°, near the Water works 52·0°, near Letter 49·6°, near Brenachoil 48·8° and 48·0°,

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near Ellen's Isle 47·4° and 47·0°, and finally at Trossachs pier 45°·3. It will thus be seen that it is very unsafe to rely on a single observation at one spot, as giving a sure indication of the temperature of the surface-waters of a loch as a whole at any given season. A year later (from June 4th to 9th, 1898) the temperature of the surface-waters of Loch Katrine was not observed to fall below 50°. On November 26, 1897, the surface-temperature varied only from 46·8° to 47·4°, and on April 13th and 15th, 1899, from 41·2° to 42·7°.

The serial temperatures in Loch Katrine are shown graphically in the accompanying curves (Fig. 11), which exhibit the march of temperature in the waters of the loch throughout the year. The curve for April shows that the water from top to bottom has a temperature ranging between 41° and 42° F. In the two curves for June the heating effect of the sun on the surface layers is indicated, but in depths beyond 20 fathoms the temperature has not been appreciably affected. In June 1898 the whole body of water in the loch was apparently slightly warmer than in the previous June. The November curve shows a great accumulation of summer heat in the layers down to depths of 30 and 35 fathoms. By this time cooling has set in, and progresses slowly until the spring, when the whole of the layers assume the nearly uniform temperature indicated by the April curve. The temperature of the bottom of the loch in depths of 400 feet may vary one or two degrees from year to year, this variation being due to the strength of the winds and general character of the climate in different years.[1] The highest temperature recorded in Loch Katrine is 58·4°, so that the range in the central parts of the loch throughout the whole year is probably about 18° F.

Loch Arklet.—Temperature observations taken in the centre of Loch Arklet on June 11th, 1897, gave a temperature at the surface of 55·4°, and at 5 fathoms 54·4°; on April 13th, 1899, the surface-temperature was 42·7°. Temperatures as high as 61° have been recorded in this loch, so that the annual range probably exceeds 29°.

Loch Achray.—Observations taken in June and November 1897 and April 1899 showed that the temperature of the surface-waters varied from 41° in April to 59·5° in June, the temperature in November being 46°. An intermediate observation at 5 fathoms in the centre on June 12th, 1897, gave 53·5°. The highest reading recorded at the surface of this loch is 64·1°, so that the annual range probably exceeds 32°.

Loch Drunkie.—Observations taken on June 12th, 1897, showed that the surface-waters had a temperature of 57°, and an intermediate observation at 5 fathoms gave 52·6°. On April 14th, 1899, the surface-temperature was 42·4°.

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[1] See Murray, "Some Observations on the Temperature of the Water of the Scottish Fresh-water Lochs" (*Scottish Geographical Magazine*, vol. xiii. p. 1, 1897). At noon on 10th March 1900, in calm and frosty weather, the temperature of the surface water of Loch Katrine, over the deepest part of the loch, was 40·3°, at 10 feet 41·2°; at all other depths down to 492 feet the temperature readings were 40° and 40·1°. On the same date the readings in shallow water were 39·4°.

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Loch Vennachar.—The temperature observations taken in June, July, and November 1897, and April 1899 showed that the temperature of the surface-water varied from 41° in April to 56·5° in June, the temperature in November being 46° to 47°, while the water of Blairgarry Stream had a temperature of 42·2°. Serial observations in the centre of the loch on June 10th, 1897, showed a gradual fall in the temperature from 55·8° at the surface to 47·2° at 15 fathoms, while on April 11th, 1899, the temperature was practically uniform from surface to bottom at 42·5° to 42·7 . .

Loch Doine.—Observations taken on July 7th, 1897, and April 10th, 1899, showed that the temperature varied from 42° in April to 54° in July. Serial observations in the centre of the loch in July gave a temperature at the surface of 54°, falling to 52·1° at 10 fathoms, while in April the temperature was found to be nearly uniform from surface to bottom, ranging from 41·8° to 42·6°.

Loch Voil.—Observations taken in July 1897 and April 1899 showed that the temperature of the surface-water varied from 41·2° in April to 56·5° in July. Serial observations taken on July 7th, 1897, showed that in the centre of the loch the temperature at the surface was 55·0°, at 5 fathoms 54·0°, and at 16 fathoms 54·5°, while farther down the loch the temperature appeared to be rather higher, viz., 56·0° at the surface, and 55·3° at 3 fathoms and 8 fathoms. Serials taken on April 10th, 1899, showed that the whole body of water was practically uniform in temperature at about 42°.

For the sake of comparison a few surface-temperatures were taken at the head of Loch Earn on July 6th, 1897, the temperature of the loch varying from 48·8° to 49·2°, while that of the streams flowing into the loch was 52·2°. On the following day (July 7th, 1897) the surface of Loch Voil near the shore had a temperature of 56·4°, and a little distance from the shore 54·6°, while the water of the burn flowing into the loch had a temperature of 53·6°, and higher up the stream 53·1°. It thus appears that the waters of Loch Voil were warmer than those of Loch Earn, and in the case of Loch Voil the stream feeding the loch had a lower temperature than the loch itself, while in the case of Loch Earn the streams were warmer than the waters of the loch.

Loch Lubnaig.—Observations were taken in Loch Lubnaig only on April 6th and 8th, 1899, and showed that at that time the temperature of the water was nearly uniform from surface to bottom, the range being only from 41·8° to 42·7°.

From the point of view of temperature the Scottish fresh-water lochs may be divided into those which freeze during hard winters, and those which never freeze. Those which freeze over in winter are shallow lochs, and when frozen the water-temperature beneath the ice is at the maximum density point of fresh water (39·1°) or lower. In spring the temperature of these shallow lochs rises much more quickly through the heat of the sun, and the whole mass of water attains a higher temperature than in the case of the deeper lochs; they also lose their heat much more quickly in the autumn than the deep lochs, and consequently have a much wider range of annual temperature. In the deep lochs—those with

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400 or more feet of depth—the temperature of the water never rises so high in summer, nor sinks so low in winter, as in the shallow lochs, and the range is much less. The temperature of the bottom water in some cases does not change more than 1° F. from year to year, and in the deepest lochs it appears to be practically constant at all times and seasons; 40° is the lowest temperature that has been recorded at the bottom in any of these deep Scottish lochs, so that the maximum density point is never reached. In summer, autumn, and even early winter, it is possible, by observing the temperature of the surface and sub-surface waters, to form a fairly accurate idea of the depth of a loch, the temperature being higher the shallower the loch. The waters from a deep loch—like Loch Katrine—are much the best for the water-supply to a city, for in summer the temperature is relatively low and in winter it is relatively high.

Pelagic and other Organisms.

Tow-net and other observations show that the nature and amount of the organic life in the fresh-water lochs are subject to great variation in the different lochs when compared with each other, and in the same loch at different seasons of the year. Large numbers of observations are being collected, and we may look for interesting results when these are in a state for discussion. Generally speaking the pelagic fauna and flora are much more abundant in the warm summer months than at other times of the year, and are also more abundant in the shallow lochs than in the deep ones. In the spring months there is a great development of Diatoms and other Phytoplankton, which render the water less transparent than at other times of the year.

Mr. Thomas Scott has lately been comparing the fauna in several of the Scottish lochs at different seasons of the year; some of his results for the lochs now under consideration may be noted.

In Loch Katrine the Entomostraca and other Invertebrates were scarcer than in the other lochs examined. Fourteen species are recorded, *Bosmina longispina* being the only species present in all the gatherings; *Leptodora* was entirely absent from the gatherings collected during the colder months. *Cyclops strenuus* and *Polyphemus* appeared to be more frequent in the upper part of the loch, and *Bosmina* and *Leptodora* in the lower part. The sides of Loch Katrine do not generally present conditions very favourable to shore-dwellers, and an examination of the shore about Stronachlachar yielded scarcely anything that differed from the tow-net captures, while at the lower end the shore between the Trossachs pier and Ellen's Isle yielded much better results. Here forty species of Crustacea were obtained, as well as one or two species of Mollusca, but they were all individually scarce. The Cladocera were more numerous in species in the warmer than in the colder months, while with the Copepoda the reverse was observed, though the difference was not so great.[1]

[1] Scott, *Seventeenth Annual Report of the Fishery Board for Scotland*, part iii. pp. 148-151, 1899.

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In Loch Arklet *Holopedium gibberum*, one of the most remarkable species of the Cladocera in Britain, was moderately common in the tow-net gatherings collected in September and November 1897, and in June 1898 it was abundant all through the water, but when the loch was visited in March 1893 not a trace of *Holopedium* could be seen. In June, when *Holopedium* was so abundant, other species previously observed were either very scarce or absent, as if they had been more or less crowded out by this particular Cladoceran. Eleven Crustacean species are recorded, *Daphnia* being the only form obtained in all the gatherings; *Bythotrephes* was observed in September and June, but not in November and March, and *Leptodora* occurred only in September. Infusoria (*Ceratium*, etc.), and micro-algæ were much less frequent in June than in the other gatherings. Forty-two species of Entomostraca were obtained by hand-net round the shores of Loch Arklet, including a few comparatively rare forms; very few Molluscs were observed in any of the gatherings.[1]

Twelve species of Entomostraca were captured by the tow-nets in Loch Achray, *Diaptomus*, *Daphnia*, and *Bosmina* being taken in all the gatherings. *Holopedium*, though common in September and June, was not observed in November and March; *Bythotrephes* also appears to be subject to somewhat similar seasonal variation. Fifty species of Entomostraca and four species of Mollusca were obtained by the hand-net, and by dragging the tow-net for a short distance over the bottom of Loch Achray. Three rare species: *Diaptomus wierzejskii*, *Lathonura rectirostris*, and *Monospilus dispar* were obtained, and in June a green fresh-water Sponge (*Spongilla fluviatilis*) appeared to be moderately common in some shallow parts of the loch.[2]

Loch Vennachar contains a rich Crustacean fauna, as well as other Invertebrates, most of which are suitable for fish food. Of forty-five species of Crustacea recorded from Lochs Katrine, Achray, and Vennachar, thirty-five species were observed in Loch Vennachar; thirteen of the species from Loch Vennachar were not observed in either Loch Katrine or Achray; fifteen of the species were common to the three lochs.[3]

Twenty-five species of Crustacea, and four species of Mollusca, are recorded from Loch Lubnaig, including a new Cladoceran (*Alona neglecta*), and one or two species new to Britain.[4]

Rainfall and Outflow.

An attempt has been made to arrive at an approximation to the total amount of rain falling annually on the drainage areas of the lochs under consideration, although the available records are far from sufficient for the purpose. Dr. Alexander Buchan, F.R.S., has kindly supplied us

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[1] Scott, *Seventeenth Report of the Fishery Board for Scotland*, part iii. pp. 143-146.
[2] Scott, *Seventeenth Report of the Fishery Board for Scotland*, part iii. pp. 153-156.
[3] Scott, *Fourteenth Report of the Fishery Board for Scotland*, part iii. p. 167, 1895.
[4] Scott, *Thirteenth Report of the Fishery Board for Scotland*, part iii., p. 247, 1894.

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with information regarding the readings of the rain-gauges at observing stations within, and in the vicinity of, the catchment-basins of these lochs. The positions of these rainfall stations, and the mean annual rainfall, are shown on one of the maps accompanying this paper (see Map III.), and further particulars will be found in the following table:—

Station.	Height of Rain-gauge above Sea-level.	Years observed.	Mean Annual Rainfall in inches.
	Feet.		
Ardlui,	50	1865-70	115·10
Firkin,	100	1866-79	98·38
Arrochar,	15	1864-98	81·31
Head of Duchray,	1800	1854-98	84·27
Glengyle,	380	1854-98	92·25
Top of hill, Loch Katrine tunnel,	830	1861-98	77·95
Brig o' Turk,	270	1854-98	64·47
Loch Drunkie,	420	1861-98	63·62
Loch Vennachar,	275	1861-98	57·31
Between Ben Ledi and Glen Finlas,	1800	1854-98	53·68
The Gart,	230	1872-98	54·47
Leny,	345	1861-98	54·23
Blaircreach,	460	1893-98	82·63
Stronvar,	422	1860-98	75·49
Lochearnhead,	320	1866-84	65·50
Tyndrum,	792	1858-61, 72-3, 76-7	90·10

Grouping these stations and their mean annual rainfall into those likely to represent the rainfall on the catchment-basin flowing out of Loch Vennachar, and those representing the rainfall on the catchment-basin flowing out of Loch Lubnaig, we arrive at an average rainfall of 76·25 inches for the Loch Lubnaig catchment, the mean height of the rain-gauges being 538 feet above the level of the sea, and an average rainfall of 75·37 inches for the Loch Vennachar catchment, the mean height of the gauges being 528 feet.

The entire catchment-basin flowing out of Loch Vennachar (*i.e.* the combined drainage-areas of Lochs Katrine, Achray, Drunkie, and Vennachar) is about 75·29 square miles, and the mean height calculated from the bulk of land above the level of the lochs is about 704·185 feet; the mean height of the surfaces of these four lochs above sea-level is 331½ feet, so that the mean height above the sea of the entire catchment is about 1035·685 feet. The entire catchment-basin flowing out of Loch Lubnaig (*i.e.* the combined drainage-areas of Lochs Voil, Doine, and Lubnaig) is about 73·39 square miles, and the mean height above the level of the lochs is about 935·129 feet; the mean height of the surfaces of these lochs above sea-level is 412 feet, so that the mean height above the sea of the entire catchment is about 1347·129 feet.

The usual practice among engineers is to add 2½ per cent. of rainfall for each 100 feet of height above rain-gauges. Applying this rule to the

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Loch Vennachar catchment-basin, where we have an observed rainfall of 75·37 inches at an average height of 528 feet, we must add 12·7 per cent. for the additional 508 feet of mean height, making an average annual rainfall over the entire catchment of 84·94 inches. This would give an annual fall of rain on the entire catchment equal to 14,857,214,000 cubic feet. Applying this rule, in like manner, to the Loch Lubnaig catchment-basin, where we have an observed rainfall of 76·25 inches at an average height of 538 feet, we must add 20 per cent. for the additional 809 feet of mean height, making an average annual rainfall over the entire catchment of 91·5 inches. This would give an annual fall of rain on the entire catchment equal to 15,600,760,000 cubic feet.

There is another method of estimating the rainfall, without taking the mean height of the drainage-area into consideration. Supposing the usually accepted increase of 2½ per cent. per 100 feet of height, and also the mean annual rainfall at the average height of the rain-gauges, to be approximately correct, it is possible to calculate the rainfall at any given height. For the Loch Vennachar catchment, the probable rainfall at the same heights and intervals as the contour-lines on the Ordnance Survey maps has been calculated from the starting-point of the mean of the observing stations, 75·37 inches at 528 feet; thus at the surface of Loch Vennachar the rainfall would be about 70·5 inches, at 500 feet above the sea 75·2, at 750 feet 79·9, at 1000 feet 84·6 inches, and so on, adding 6¼ per cent. for each succeeding interval of 250 feet. Multiplying the area between any two consecutive contour lines by the mean of the two figures calculated for the same two lines should give an approximation to the amount of rain falling on that area. The result as obtained by this method for the entire catchment-basin flowing out of Loch Vennachar is given in the following table—

							Cubic feet.
Level of lochs to	500 feet,	16·53	square miles	×	72·8	inches	= 2,795,710,000
500 „	750 „	10·67	„	×	77·5	„	= 1,921,117,000
750 „	1000 „	10·35	„	×	82·2	„	= 1,976,514,000
1000 „	1250 „	9·46	„	×	86·9	„	= 1,909,847,000
1250 „	1500 „	10·22	„	×	91·6	„	= 2,174,874,000
1500 „	1750 „	7·86	„	×	96·3	„	= 1,758,476,000
1750 „	2000 „	5·94	„	×	101·0	„	= 1,393,784,000
2000 „	2250 „	3·06	„	×	105·7	„	= 751,422,000
2250 „	2500 „	0·99	„	×	110·4	„	= 253,917,000
over	2500 „	0·21	„	×	115·1	„	= 56,154,000
					Total		14,991,815,000

This result comes very near to that obtained from the calculation based upon the mean height, which gave a total annual rainfall of 14,857,124,000 cubic feet.

Applying the same method to the entire catchment-basin flowing out of Loch Lubnaig, we arrive at the following result :—

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					Cubic feet.
Level of lochs to	500 feet,	6·82 square miles	×	74·6 inches	= 1,181,982,000
500 „	750 „	7·15 „	×	77·9 „	= 1,293,991,000
750 „	1000 „	9·05 „	×	82·7 „	= 1,738,769,000
1000 „	1250 „	9·70 „	×	87·4 „	= 1,969,568,000
1250 „	1500 „	9·89 „	×	92·2 „	= 2,118,434,000
1500 „	1750 „	9·43 „	×	97·0 „	= 2,125,060,000
1750 „	2000 „	8·06 „	×	101.7 „	= 1,904,337,000
2000 „	2250 „	6·64 „	×	106·5 „	= 1,642,879,000
2250 „	2500 „	3·40 „	×	111·3 „	= 879,148,000
2500 „	2750 „	1·88 „	×	116·1 „	= 507,081,000
2750 „	3000 „	1·02 „	×	120·8 „	= 286,256,000
over 3000	„	0·35 „	×	126·6 „	= 102,941,000
		Total,	.	.	15,750,446,000

Here, again, there is a close agreement between the result obtained by this method and that calculated from the mean height, which gave a total annual rainfall of 15,600,760,000 cubic feet.

A third method of estimating the amount of rain falling on any particular region is afforded by drawing lines of equal rainfall, measuring the areas between the lines, and multiplying by the mean annual rainfall. Where the lines are based upon sufficiently numerous records of the rainfall at various heights, this method should give excellent results; but in the cases under discussion the number of observing stations is small, and the majority of the rain-gauges are situated on the low-lying grounds, only two being placed at heights exceeding 1000 feet, both at 1800 feet: therefore the figures obtained in these cases are most probably below the truth. Nevertheless, we have attempted to lay down the lines of equal rainfall from the available records, as shown on the rainfall map accompanying this paper (see Map III.). The areas enclosed by the lines of rainfall have been measured with the planimeter, and the rainfall calculated for the Loch Vennachar catchment-basin, with the following results :—

					Cubic feet.
50 to	60 inches,	12·35 square miles	×	55 inches	= 1,578,040,000
60 „	70 „	28·97 „	×	65 „	= 4,374,714,000
70 „	80 „	18·93 „	×	75 „	= 3,298,372,000
80 „	90 „	8·55 „	×	85 „	= 1,688,400,000
90 „	100 „	4·21 „	×	95 „	= 929,166,000
100 „	110 „	2·28 „	×	105 „	= 556,175,000
		Total,	.		12,424,867,000

In like manner, the rainfall has been calculated for the Loch Lubnaig catchment-basin, with the following results :—

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				Cubic feet.
50 to 60 inches,	3·79 square miles	× 55 inches	=	484,272,000
60 „ 70 „	23·89 „	× 65 „	=	3,607,591,000
70 „ 80 „	21·79 „	× 75 „	=	3,796,700,000
80 „ 90 „	19·02 „	× 85 „	=	3,755,928,000
90 „ 100 „	4·41 „	× 95 „	=	973,307,000
100 „ 110 „	0·49 „	× 105 „	=	119,530,000
	Total, .			12,737,328,000

The results obtained by these three methods may be summarised thus :—

	Vennachar catchment.	Lubnaig catchment.
First method, . .	14,857,214,000	15,600,760,000
Second „ . .	14,991,815,000	15,750,446,000
Third „ . .	12,424,867,000	12,737,328,000
Mean, .	14,091,299,000 c. ft.	14,696,178,000 c. ft.

Since Loch Katrine has been made use of by the Glasgow Corporation as the source of the water-supply to that city, a record has been kept of the amount of water flowing out of Lake Vennachar—or rather, a record has been taken twice a day of the depth of water flowing over a weir at Coilantogle, from which the quantity of water discharged may be calculated. When the height of the water on the weir exceeded five inches, the weir became a drowned weir, so that it was difficult to estimate the outflow as there was a considerable velocity of approach, especially during floods.

Mr. Gale has kindly supplied us with the readings, taken twice a day during the year 1869, of the depth of the outflowing water at Coilantogle, and from these figures the outflow has been estimated for that year at 9,572,000,000 cubic feet. The year 1869 was the driest year during a period of twenty-four years, and we are not satisfied that this computation can be accepted as a very correct estimate of the outflow from this catchment-basin even for that year. It would have been interesting to have calculated the outflow for twenty-five years in the same way as we have done for the year 1869, and to have taken the mean. However, accepting the above estimate for the year 1869, and adding to it the quantity of water supplied to Glasgow for that year, which, from Mr. Gale's table showing the average amount of water supplied per day during the first six months of the years 1866 and 1871, may be taken at about 1,659,300,000 cubic feet, we find that the mean rainfall exceeds the outflow in this year by

According to the first method, . . .	3,625,914,000 cubic feet.
„ „ second „ . . .	3,760,515,000 „
„ „ third „ . . .	1,193,567,000 „
or a mean of . .	2,859,999,000 „

Leslie[1] made experiments for twenty consecutive years on the

[1] See *Journ. Scot. Met. Soc.*, vol. v. p. 108, 1878.

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allowance to be made for absorption by vegetation and for loss by evaporation, and he calculated that the average annual amount of water absorbed and evaporated is equal to about thirteen inches of rainfall. On this basis, and assuming for the present that the evaporation from the surface of the water is equal to absorption and evaporation from the land, the total amount of water lost through absorption and evaporation over the entire catchment-basin of Loch Vennachar would be about 2,273,885,000 cubic feet per annum.[1] Comparing this figure with the figures given above showing the excess of rainfall over outflow, we observe that, according to the mean of the three methods, the difference between the rainfall and outflow is greater than would be accounted for by absorption and evaporation as estimated by Leslie, there being an excess according to the first two methods, and a deficiency according to the third method.

The foregoing figures, calculated for the year 1869, show that the rainfall unaccounted for by outflow at Coilantogle, and supply of water to Glasgow, is according to the first method 26 per cent., according to the second method 27 per cent., and according to the third method 8 per cent.: this percentage must be referred to loss by absorption, evaporation, and the loss of water through underground channels.

NOTES ON THE GEOLOGY OF THE LOCH KATRINE DISTRICT, by Messrs. Ben. N. Peach, F.R.S., and John Horne, F.G.S., from unpublished observations made during the course of the Geological Survey of Scotland.

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All the lochs referred to in this paper, with the exception of Loch Arklet, lie within the catchment-basin of the river Teith above Callander. Though situated about a mile to the west of Loch Katrine, the small lake, Loch Arklet, drains into Loch Lomond.

1. *Geological Structure of the area embracing these Lochs.*

All the lochs, save the lower part of Loch Vennachar, lie within the territory of the crystalline schists of the Highlands, which are bounded along the Highland border by a powerful fault stretching from Stonehaven to the Firth of Clyde. As shown on the geological sketch-map accompanying this paper, this dislocation extends from Aberfoil north-east by Leny to Luirgeann on the Kelty Water. On the south-east side of this fault the strata belong to the lower Old Red Sandstone formation, comprising, next the fault, andesitic lavas and agglomerates well seen in the Kelty

[1] The evaporation from the surface of the lakes will, of course, exceed Leslie's figures for loss through absorption and evaporation.

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Water. Farther to the south-east there is a broad belt of conglomerate arranged in beds, which are inverted or vertical near the fault, and as the observer approaches the plain they dip towards the south-east and pass underneath the overlying red sandstones.

On the north-west side of this great boundary fault of the Highlands there is a narrow strip of sedimentary rocks about half a mile in breadth, referred provisionally to the Arenig division of the Silurian system, and consisting of red and black shales, radiolarian cherts, limestones and grits.

To the north of this belt of doubtful strata, the whole of the area included in the geological map accompanying this paper is occupied by rocks grouped under the general term of the crystalline schists of the Highlands. The latter are arranged in a definite order, but as yet it is uncertain whether it indicates the original sequence of deposition. The groups are here given in apparent descending order:—

7. Garnetiferous mica-schists.
6. Loch Tay limestone with sills of epidiorite.
5. Mica-schists with sills of epidiorite.
4. Schistose epidotic grits ("Green Beds").
3. Ben Ledi grits, massive and sometimes schistose.
2. Aberfoil slates with subordinate bands of grit.
1. Leny and Aberfoil grit.

For a distance of about five miles northwards from the great boundary fault, the members of groups 1 to 4 are arranged in more or less parallel belts or strips running south-west and north-east, the strata dipping at high angles to the north-west. The groups appear in consecutive order, the Leny and Aberfoil grit being exposed immediately to the north of the doubtful Arenig rocks, while the Aberfoil slates and Ben Ledi grits appear successively to the north. The schistose epidotic grits (group 4) which lie apparently at the top of the Ben Ledi grits are developed still farther to the north, being traceable from a point not far to the south of Ben Lomond, north-east by Loch Chon and the lower part of Loch Katrine, thence across the hills to Strathyre and Loch Voil. From the Braes of Balquhidder they can be followed northwards to Glen Dochart, and they reappear in Glen Falloch in the extreme north-west part of the map. At the head of Loch Lubnaig and in the Braes of Balquhidder sills or intrusive sheets of epidiorite occur at no great distance from the "Green Beds."

In the belt between Loch Chon and Loch Lubnaig the "Green Beds" together with the Ben Ledi grits form a series of compound synclinal folds, the strata being inclined at high angles. To the north and west of the "Green Beds" the representatives of the Ben Ledi grits reappear and cover a wide area, extending from Ben Lomond north-east by Loch Katrine and the heights surrounding the head of Loch Voil, northwards by Ben More and westwards to Glen Falloch. Throughout this extensive area the strata are inclined at gentle angles: in marked contrast with the structure along the Highland border already indicated. There is here a change, over part of the area at least, in the lithological characters of the Ben Ledi grit group. The strata become more schistose and micaceous, merging in places into mica-schists. The accompanying geological map

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shows generally where these grits still retain their massive character and where they merge into mica-schists.

The outcrop of the Loch Tay limestone is indicated on the geological map, from which it will be seen that this limestone, together with the sills of epidiorite, is traceable from the upper part of Strathyre, by the Kirkton Glen, to Luib in Glen Dochart.

In addition to the great boundary fault already referred to, separating the lower Old Red Sandstone from the crystalline schists, various faults trending NNE. and SSW. traverse the south-east part of the area under consideration. These are, in the main, branches of the great dislocation which has been traced across the Highlands for a distance of 60 miles from Loch Vennachar by Loch Lubnaig and Loch Tay to Glen Tilt. In common with the dislocation referred to, the branch faults have a downthrow to the west or north-west, and they shift for some distance the outcrops of the strata which they traverse. They are truncated by the great boundary fault of the Highlands and may be of pre-Old-Red-Sandstone age.

The existing valley-system of the basin of the Teith has been carved out of a tableland of crystalline schists of varying hardness. Though there is conclusive evidence of great erosion during the successive glaciations of the region, yet it is clear that the present valley-system must have been developed in pre-glacial time. There is one point connected with the geological structure of this region which has had an important bearing on the evolution of the valley-system. Along the Highland border, as already indicated, there is a great development of conglomerates, coarse pebbly grits, and greywackes, belonging partly to the crystalline schists and partly to the Old Red Sandstone. These strata, being vertical or nearly so, would be much less easily eroded than the gently inclined schistose rocks lying to the north-west. Such an arrangement would naturally lead to the formation of narrow and comparatively flat-bottomed valleys behind rocky gorges, the latter being cut through the vertical beds of hard grit and conglomerate along the Highland border. That this remarkable structure must have likewise contributed to the erosion of rock-basins during the glacial period will become apparent on a closer examination of the geological structure of the area traversed by the larger lakes.

In the case of Loch Katrine, which is the largest and deepest of the lochs under consideration, there is a great rocky barrier at its outlet due to the Ben Ledi grits. Here they form a belt over a mile in breadth, and give rise to the rugged scenery so characteristic of that region. They appear on the crags of the Trossachs at the mouth of the loch, on the crest and slopes of Ben Venue (2393 feet), on Ben Bhreac (2295 feet), and on the heights round Ben An (1326 feet). The strike of these hard and durable strata is ENE. and WSW.—that is, at right angles to the outlet of the loch, and the beds are vertical or highly inclined.

The potency of the Ben Ledi grits as a rocky barrier must have been considerably increased by the development of epidotic grits or "Green Beds" lying immediately to the north. The latter, though not so massive as the Ben Ledi grits, are hard and durable; they are repeated

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by a series of compound folds for nearly a mile across the strike, their northern limit being near Brenachoil Lodge. Their trend is likewise north-east and south-west, and the beds are vertical or highly inclined.

On both sides of Loch Katrine above Brenachoil Lodge the geological structure is widely different, for in this area the Ben Ledi grits, greywackes, and slates reappear in a highly schistose form, the strata dipping generally at low angles to the south-east. Over much of this region, as already indicated, the altered sediments merge into mica-schists owing to the development of mica. It is obvious that these materials would yield more readily to the agents of denudation than the massive pebbly grits of Ben Venue and the Trossachs.

Loch Achray, which lies about a mile to the east of the outlet of Loch Katrine, is only about 88 feet below the level of the latter loch. A powerful fault or dislocation, trending north-east and south-west, crosses the head of the loch near the Trossachs Hotel, which brings the massive Ben Ledi grits to the west in contact with slates to the east. It is a true rock basin which has been excavated mainly in the group of less durable slates.

Loch Vennachar is crossed by the great boundary fault, already referred to, along the Highland border, the floor of the eastern portion being composed of Old Red Sandstone conglomerate, while that of the western part is formed of grits and slates belonging to the crystalline schists. Though there is a covering of drift on both sides of the lower part of the loch, still this sheet of water forms a true rock basin, for the Old Red conglomerate is exposed in the river about 1200 yards below the outlet.

Loch Drunkie presents several interesting geological features. On referring to the map it will be seen that an arm of this loch runs nearly east and west for upwards of half a mile; the northern margin is composed of massive grits, while the southern margin and probably the floor of this branch of the loch is formed of less durable slates. Another arm of this lake runs NNE., in the direction of Loch Vennachar, the eastern margin of which nearly coincides with the course of a fault that crosses Loch Vennachar to the east of Lanrick.

The three lakes, Loch Doine, Loch Voil, and Loch Lubnaig, must have formed one continuous sheet of water in post-glacial time. Loch Doine is now separated from Loch Voil by two cones of alluvium, to be referred to presently. Loch Voil is separated from Loch Lubnaig by a narrow plain of alluvium five miles in length, the surface of Loch Lubnaig being nine feet lower than that of Loch Voil. These lochs form isolated parts of a true rock basin. Below the outlet of Loch Lubnaig there is a prominent rocky barrier composed of the massive grit of Leny and Aberfoil, from a half to three-quarters of a mile in breadth. The strike of this pebbly grit is north-east and south-west, and the beds are inclined to the north-west at high angles.

Loch Lubnaig is traversed by several faults, to which special reference will be made in the sequel. The lower part of the loch coincides with the trend of two faults, which, in all likelihood, determined for some distance the course of the river in remote geological time.

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2. *Glaciation.*

The glacial phenomena in the lake district of the basin of the Teith prove beyond doubt that, during the climax of the ice-age, the ice-shed lay to the north of the area now under consideration; that the ice-movement was more or less independent of the existing valley-system; and that even the highest mountains were over-ridden by the ice. This great development was followed by a period of local glaciation, when the glaciers were confined mainly to the existing valleys, and when the boulder-clay or ground-moraine of the earlier period was largely removed. The upper limit of the valley glaciation is frequently defined by prominent lines of moraines strewn with boulders, which rise to a considerable height on the mountain-slopes. The evidence pointing to these conclusions may now be briefly summarised.

On the watershed to the north of Lochs Doine and Voil, the trend of the ice-movement during the great glaciation, as proved by the striæ, was SSE. Again, on the lofty watershed east of Loch Lubnaig and south of Loch Earn, between Ben Each (2660 feet) and Ben Vorlich (3224 feet), there is conclusive evidence that the highest mountains in that part of the lake district were over-ridden by the ice. There the mountains are composed of grits, and the striæ are well preserved. On Ben Each the striæ point SE.; on the col between that hill and Stuc a Chroin, S. 40° E.; on the latter mountain about SE., and on the slopes of Ben Vorlich, at a height of 2500 feet, the trend of the ice-markings is E. 40° S. In the tract between Loch Lubnaig and Loch Katrine similar evidence is obtained of a south-easterly movement at great elevations. For example on Ben Vane (2685 feet), at a height of 2642 feet, the striæ point S. 15° to 20° E.; on the north and west slopes of Ben Ledi, S. 35° E., and on the crest of that mountain, at a height of 2875 feet, the direction is SE. In like manner the mountains guarding the outlet of Loch Katrine are glaciated to the summit. Striæ occur on the top of Ben Venue at a height of 2386 feet, pointing S. 40° E.; on Ben An, at an elevation of 1750 feet, E. 30° S.; and on Ben Bhreac, to the west of Ben Venue, the direction of the ice-markings is S. 30° to 40° E. Again, on the watershed between Loch Voil and Loch Katrine, the evidence indicates a south-easterly movement during the greatest extension of the ice. For instance, at various points on Taobh na Coille, at elevations between 2000 feet and 2250 feet, the striæ point S. 30° E., and on Meall Gaothach, S. 30° E. In the tract immediately to the south-west of Loch Katrine the trend of the ice-markings varies from SSE. to ESE. For example, on Maol Mor (2249 feet) about the 2000-feet contour-line, to the north of Loch Arklet, the direction is about S. 15° E.; and on the crest of Ben Uaimhe, to the south of that loch, S. 10° to 15° E. Eastwards, throughout the tract between Loch Chon and the Trossachs, the trend is ESE. To the south of the lofty heights stretching from Ben Venue towards Ben Ledi, the direction of the striæ is more easterly, thus showing that the ice, after crossing the high ground, was deflected more towards the east (see glacial striæ on Map II.)

The general south-easterly movement of the ice during the great

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glaciation, throughout the lake-district of the basin of the Teith, is confirmed by the dispersal of stones in the boulder-clay, and by the transport of erratics. Many of the boulders have been carried far from their source, and are now found on the tops of the highest mountains of the district, some even at greater elevations than the parent rock.

To the east of Loch Lubnaig, on Ben Vorlich, at a height of 3000 feet, boulders of garnetiferous mica-schist are found resting on glaciated surfaces of pebbly grit. Again, on the same mountain, at a similar elevation, there are erratics of epidiorite and hornblende-schist—rocks which are associated with the Loch Tay limestone, and which must have been transported from lower ground to the north. Similar boulders are met with on Stuc a Chroin and on Ben Each. Again, in the boulder-clay on the slopes of Ben Ledi, blocks of hornblende-schist occur, which must have been transported for some distance. On the south side of Loch Katrine, between Stronachlachar and the aqueduct of the Glasgow waterworks, boulders of quartzite and garnetiferous mica-schist, which are foreign to the basin of Loch Katrine, are found in the boulder-clay. Eastwards near Brenachoil Lodge, on the north side of Loch Katrine, there are blocks of black schist, like that which accompanies the quartzite of central Perthshire, and which has not been detected within the catchment-basin of Loch Katrine. These examples are sufficient to prove that, during the climax of the glacial period, the ice-movement was independent of the existing valley-system. Indeed, from the evidence furnished by the striæ and the transport of boulders, it may be inferred that the minimum thickness of the ice-sheet during this period must have been not less than 3000 feet in the lake-district of Perthshire.

The boulder-clay or ground-moraine, which was laid down during the great glaciation, must have been extensive, for it is found at great elevations, and it sometimes attains a great thickness. For instance, in the lee of the ridge of Ben Vane, to the west of Loch Lubnaig, it reaches a height of 2290 feet, and in places it is over 100 feet thick. But a large part of this deposit was removed during the later glaciation by the valley glaciers, for the relics occur above the limits of the valley-moraines, the latter resting on the solid rock.

Only a brief allusion is necessary to show the development of the later glaciers. The striæ produced by this later movement coincide generally with the trend of the existing valleys. But though this is true, there is evidence to prove that even the larger valley-glaciers were thick enough to overflow minor watersheds. For instance, the glacier which descended the basin of Loch Katrine was thick enough to override the low col between that loch and Loch Chon, while another branch passed westwards by Loch Arklet towards Loch Lomond. Another example of the same phenomenon might be quoted. The glacier which descended the basin of Loch Voil towards Loch Lubnaig was thick enough to overflow the col between Strathyre and Loch Earn, while another branch ascended Glen Buckie and joined the Loch Lubnaig glacier at Laggan.

Moraines are well developed in most of the valleys, and are frequently

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arranged in concentric lines, as in Glen Finglas north of Brig o' Turk. On the south side of Loch Katrine, between the jetty and Glasahoile, the moraines are distributed in parallel lines along the shore of the lake. As already indicated the upper margins of the valley-glaciers are defined by the moraines.

3. *The Soundings viewed in Relation to the Geological History of the Area, and with Reference to the Origin of the Lakes.*

Loch Doine, Loch Voil, and Loch Lubnaig.—Reference has already been made to the fact that, in post-glacial time, Loch Doine, Loch Voil, and Loch Lubnaig must have formed one continuous sheet of water, and that their subsequent isolation has been due to the deposition of sediment.

Loch Doine has been separated from Loch Voil by alluvial cones laid down by two streams, one from the north at Monachylemore and another from the south at Monachyle Tuarach. The 50-feet subaqueous line has been traced round the Loch Doine basin, and the deepest sounding is 65 feet. At the head of this loch there is an alluvial flat that stretches westwards for 1½ miles, formed by the Lochlarig river and its tributaries. The gradual silting up, which is in constant progress at the head of Loch Doine at the mouths of the Lochlarig river and Allt Carnaig, is well shown by the resultant curve in the 50-feet contour-line.

That Loch Voil is merely a continuation of the Loch Doine basin is further proved by the soundings, for immediately to the east of the cones just referred to, the 50-feet contour-line is met with, and has been traced round both sides of the loch eastwards to about Ledereich—a distance of about two miles. From this point eastwards the lake gradually shallows towards the alluvial flat at Balquhidder, where moraines occur within 400 yards of Kirkton and Stronvar Bridge. The deepest part of the lake is enclosed by the 90-feet contour-line at the head of the loch near Monachylebeg, and the deepest sounding within this line is 98 feet.

The trend of Lochs Doine and Voil roughly coincides with the strike of the crystalline schists in that district. It is oblique—indeed nearly at right angles—to the movement of the great ice-sheet during the climax of glacial conditions, and it harmonises with the course of the later valley-glacier. Several small faults occur on the Braes of Balquhidder, north of Loch Voil, and on the hill-slope south of Loch Doine, but these are of little structural importance.

The long stretch of alluvium that separates Loch Voil from Loch Lubnaig has been laid down by the Calair burn in Glen Buckie, by the Kirkton burn at Balquhidder, and by various streams on both sides of Strathyre. The silting up now in progress at the head of Loch Lubnaig is well shown by the tongues of alluvium, on both sides of the Balvag river, that project for some distance into the loch and isolate small basins of fresh water. About half a mile north of Loch Lubnaig a moraine rises out of the alluvium, probably a fragment of the adjacent moraine on both sides of the valley. As the top of this moraine probably rose

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above the level of the ancient united lake, the depth of the latter near this locality could not have been very great.

A glance at the chart of Loch Lubnaig will show that its floor is much more irregular than that of Loch Voil. This may be accounted for partly by the presence of alluvial cones formed by various streams, and by features connected with the geological structure of the basin.

The deepest parts of this lake form two basins enclosed by the 100-feet contour-line, one to the north and the other to the south of Ardchullarie More. The upper one, about 500 yards long, is 146 feet deep, and the lower one, about 900 yards long, is 108 feet in depth. Though now separated by alluvial detritus brought down by the Ardchullarie burn from the north-east, and by the Dubh Shruith burn from the south-west, these basins were probably originally continuous. The powerful Loch Tay fault with a NNE. and SSW. course, and with a downthrow to the west, crosses Loch Lubnaig immediately to the south of Ardchullarie More and strikes the west margin of the lake near the spit of sand to be referred to presently (see Map II.) The steep gradient on the west side of the lake to the north and south of this spit of sand coincides with the course of the Loch Tay fault. About a quarter of a mile to the west of the Loch Tay fault a minor dislocation, with a similar trend and downthrow, crosses the lake and follows the channel of the Dubh Shruith burn. Now the lower deep basin lies to the east or upthrow side of the Loch Tay fault, and the upper deep basin is on the west or downthrow side of the Dubh Shruith fault. These dislocations doubtless produced brecciation of the strata along the lines of movement, which led to more rapid disintegration of the materials.

Close to the north-west limit of the upper basin enclosed by the 100-feet contour-line the loch shallows to 20 feet, and from thence northwestwards to a point opposite Bienacreag the depth increases to 62 feet. Here there is a small basin enclosed by the 50-feet contour-line.

At the lower end of the loch, on the east side, there is a steep gradient which coincides with a line of fault, having a downthrow to the west (see Map II.) As already indicated, this dislocation together with the Loch Tay fault may have determined in part the course of the river in remote geological time. But an impartial consideration of the evidence furnished by the soundings shows that the faults cannot account for the erosion of the lake basin. The striking fact that the lower deep basin of Loch Lubnaig coincides with the upthrow side of the Loch Tay fault—the most powerful dislocation traversing the crystalline schists of this area—shows that this rock-basin must be ascribed to an erosive agent acting independently of the lines of fault. It has further been shown that Lochs Voil and Doine must have been originally continuous with Loch Lubnaig. The deepest sounding in Loch Voil is 98 feet, and in Loch Lubnaig 146 feet, and it is obvious that their erosion must be ascribed to a common cause. The upper part of Loch Lubnaig coincides roughly with the trend of the ice-sheet during the great glaciation, which, from the evidence adduced in the foregoing pages, must have attained a minimum thickness of 3000 feet. But the basin must have undergone further erosion by the large valley-glacier.

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About half a mile to the south of Ardchullarie More, on the west margin of Loch Lubnaig, there is a prominent spit of sand extending into the lake for about 100 yards. It occurs not far to the south of the bend in the lake, at the meeting point of the waves produced by the prevalent westerly winds. By the action of the waves the sand is steadily borne outwards on both sides of the spit, and from the soundings it is clear that this feature projects far into the lake. Further, it must have been in process of formation when the loch stood at a higher level, for a section appears in the adjacent railway cutting, which shows the sloping layers of sand coinciding with the form of the spit.

Loch Lubnaig originally extended to a point below Coireachrombie, about three-quarters of a mile below its present outlet. This portion has been silted up by the detritus laid down by the Stank and Anie burns. The original southern termination of the lake touched the rocky barrier formed by the Leny grit. It is worthy of note also that the level of Loch Lubnaig has been lowered about 20 feet by the denuding action of the river Leny.

Loch Katrine.—For a distance of four miles west from Brenachoil Lodge to Stronachlachar—about the half of the total length of the loch—this lake has a comparatively flat bottom, enclosed by the 400-feet contour-line. The deepest sounding in Loch Katrine, 495 feet, is at the eastern limit of this basin, nearly due south of Brenachoil. The chart shows that the soundings throughout this basin gradually increase in depth eastwards to Brenachoil Lodge. The position of the deepest sounding is of interest, seeing that the strata which form the floor of the lake at this point consist of schistose micaceous grits, to the north-west of the epidotic grits ("Green Beds") and the Ben Ledi grits, the two latter groups having formed the great rocky barrier at and above the outlet of the lake.

Near the upper end of the loch a rocky barrier crosses the lake from Portnellan by the Black Island to Rudha Maoil Mhir an-t Salainn. The deepest sounding along this barrier is 90 feet, and the shallowest is 48 feet. On its lower side the 100-feet contour-line wellnigh crosses the lake. Above it there is another basin over half a mile in length, the greatest depth of which is 128 feet, immediately in front of the rocky ridge just referred to. Westwards, the lake shallows, and at its head it has been silted up for a distance of half a mile by the alluvium laid down by the Gyle river.

Below Brenachoil Lodge the soundings show an uneven floor, due probably to ridges of rock rather than to morainic deposits, if we may judge from the geological features on both sides of the lake. Ellen's Isle is composed of epidotic grits ("Green Beds"), and the promontories of Am Priosan partly of "Green Beds" and partly of Ben Ledi grits. The promontory between the pier and the sluice is formed of Ben Ledi grits.

During the geological survey of that region several small faults were found to cross Loch Katrine, but these are of minor importance, and have produced locally a slight brecciation of the strata. It is a typical example of a rock basin. The deepest sounding occurs in the front of the

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great rocky barrier in the lower part of the lake, in accordance with what we might naturally expect on the theory of glacial erosion. Though the soundings prove the deepest part of the lake to be 131 feet below sea-level, yet this depth is in proportion to the vast thickness of the ice during the successive glaciations of the basin.

Loch Achray.—This lake forms one basin, the deepest part being enclosed by the 90-feet contour-line, and the deepest sounding being 97 feet. A fault, with a downthrow to the west, crosses the head of the loch at the Trossachs Hotel, which has produced considerable brecciation of the strata, a feature probably continued along the floor of the loch between the hotel and Achray. The greater part of this lake is on the upthrow side of the fault just referred to, and the basin, as already indicated, has been excavated mainly in slates.

Loch Vennachar.—Between Loch Achray and Loch Vennachar there is a strip of alluvium, the difference in level between the two lakes being six feet. The successive terraces show that these two lakes originally formed one sheet of water, which stood at a somewhat higher level. Loch Vennachar contains one prominent basin, about two miles in length, enclosed by the 50-feet contour-line. Within this limit there are two smaller basins which fall below the level of the 100-feet contour-line (see Map V.). The deepest sounding is 111 feet, which occurs to the north-east of Invertrossachs, on the line of the great boundary fault along the Highland border, which has a downthrow to the south-east. West of this dislocation the floor of the lake rises sharply to a level of 20 feet below the surface. Westwards, however, near Lanrick, the depth increases to 50 feet, a feature which coincides with the course of two faults crossing the loch—branches of the Loch Tay fault, and each having a similar downthrow to the west. Doubtless where the deep soundings coincide with lines of fault the strata have been much shattered and crushed, which has led to the more rapid disintegration of the materials. But though these faults may have led to local modifications of the floor of the lake, they obviously do not account for the excavation of the basin. The long narrow hollow, crossing obliquely these lines of dislocation, points to glacial erosion.

Loch Drunkie.—Reference has already been made to the geological features of this basin (see page 228). In the western portion of the west branch, where the hollow has been scooped out of slates, a small part of the floor is enclosed within the 50-feet contour-line. The deepest sounding, 97 feet, occurs in the north branch of the lake in front of a ridge to the east, which rises to a height of about 150 feet above the loch. The direction of the striæ at Loch Drunkie is E. 20° S., and the deepest sounding is found where the erosion must have been greatest.

Loch Arklet.—This lake lies across the path of the great ice-sheet, and coincides with the trend of the later movement (see pages 229 and 230). Both the north and south shores of this loch are surrounded by moraines, but though such is the case, the stream flows over solid rock, where it leaves the alluvial flat 1½ miles west of the outlet, and continues to flow for half a mile over solid rock. Originally the lake must have

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extended westwards to this barrier, for the intervening strip of alluvium has been laid down by the burns joining the Arklet water not far from the outlet. On this flat there are moraines rising up in the midst of the alluvium. The greatest depth of the loch is 67 feet. At the upper or east end, where the loch is shallow, two islets appear, one formed of solid rock and the other of moraine matter.

The soundings of the various lakes in the basin of the Teith above Callander, when viewed in connection with the geological structure and glacial phenomena of that area, furnish strong evidence in support of the theory of their excavation by ice-action. It is probable that, though the lakes lie, as a rule, across the path of the great *mer de glace*, they may have been partially eroded by that ice-sheet; at the same time there can be little doubt that their final modification must have been produced by the large valley-glaciers.

THE COMMERCIAL POSSIBILITIES OF BRITISH CENTRAL AFRICA.

By PATRICK ROBERTSON,

Late Chief Accountant to the African Lakes Company, B.C.A.

BRITISH CENTRAL AFRICA is the wide name for a very wide country, and in the following notes I purpose confining myself to the comparatively small section of it known as the British Central Africa Protectorate, and particularly the Shiré Highlands. The natural and chief route to British Central Africa is through the Chindé mouth of the Zambezi, up that river for about 150 miles, and thereafter by its tributary the Shiré to Katunga's and Chikwawa near the foot of the Murchison cataracts. Thereafter there is a long portage of between 60 and 70 miles before navigable water is again reached on the Upper Shiré at Matopé and Mpimbi. The transport on the rivers in British Central Africa is accomplished by flat-bottomed stern-wheel steamers and barges, and on Lakes Nyasa and Tanganyika by screw-steam vessels of slight draft. The land transport is almost entirely confined to native carriers, as the roads of the Protectorate are often unsuitable for wagon carriage, frequently suffering not only from steep grades, but also from the heavy wash caused by tropical rains.

Blantyre, the commercial capital of British Central Africa, is situated in the Shiré Highlands, at an elevation of about 3400 feet, nearly midway in the portage between the Lower and Upper Shiré rivers. Surrounded by an amphitheatre of hills, it is well protected from the malarial winds of the low country, and statistics prove not only its immediate locality but the Shiré Highlands generally to be well suited for European residence.

The Shiré Highlands are well wooded, and the rainfall has usually proved ample for the various cultivations pursued. At an elevation suitable for most tropical and sub-tropical plants, and with a naturally

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rich soil, its products, both indigenous and introduced, are very varied. Amongst others, the following are found growing wild: chillies, cardamoms, coffee, and indigo. Rubber from the Landolphia creeper has of late years proved a valuable and large source of revenue, and the export of that valuable drug, strophanthus seed, is only limited by the home demand, great quantities of it being found in the Lower Shiré valley, Bandawe district, and in the low countries under the administration of the British South Africa Company farther west. The natives cultivate large gardens of maize, millet, cassava, numerous varieties of beans and peas, sweet potatoes, yams, etc. Some years ago the Cape gooseberry was introduced, and this most excellent fruit now grows wild

Drying Coffee on Mats.

all over the bush, as does also the tomato. These two plants in fact, take the place in any neglected spot in the Shiré Highlands of the common nettle in this country. The castor-oil plant also grows in a wild and semi-wild state, and is found a great nuisance in the coffee estates, owing to its persistent vitality. Comparatively few of our home fruits are a success, though apples, strawberries, and rasps are not unknown; but the supply of European vegetables is of a variety and quality which Covent Garden might find it hard to rival. In the early days of the European settlement of the Shiré Highlands the attraction of elephant-hunting was so great that settlers unfortunately neglected the planting of useful fruit-trees, but this oversight is now being quickly remedied, and already very fair supplies of oranges, limes, lemons, mangos, loquats, peaches, and guavas are obtainable. Such fruits as the

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pineapple, granadilla, fig, and pomegranate are quite common, whilst the Mvera Mission on the high country to the west of Lake Nyasa writes to the *Central African Times* that its grape-vines imported from Cape Colony have fruited in a very satisfactory manner. The banana of the country is so very creditable and prolific that its cultivation is left almost entirely to the natives, though it is also employed to form avenues on coffee estates.

Iron is very abundant over all British Central Africa, and excellent coal and lime are found in several places, as also other useful minerals, such as mica in large sheets, plumbago, etc., but none of these are worked except iron in a small way by the natives.

Dismissing the possible discovery in payable quantities of gold and precious stones, the commercial possibilities of the country are very great.

In the low country of the Lower and Upper Shiré, and the borders of Lake Nyasa, rice for millions could be very cheaply produced. On the Elephant Marsh alone (presently left over as a big-game preserve) there is an immense area extending to many thousands of acres, eminently suitable for the cultivation of sugar and rice. The land is practically flat and the soil a very deep alluvium, and it only requires capital for pumping machinery (for irrigation), steam-ploughs, etc., and then thousands of tons of rice could be raised at a price which would compel recognition by its low price, and would find a ready market not only in the country, but likewise on the coast and probably on the mines at Johannesburg. To judge of the suitability of this cultivation, it may be mentioned that from quite a small area at Kota-Kota on Lake Nyasa there were raised in 1898 over three hundred tons of beautiful large white rice, increased last year by a considerable tonnage. This rice was sold by the natives at about ½d. per lb., and with labour-saving devices it could be produced at a lower figure.

As previously stated, this land is equally suitable for sugar cultivation, as in fact is the whole valley of the Shiré and Zambezi rivers. So great success has already followed its adoption by a large company at Mopea on the Zambezi (almost directly opposite Mrs. Livingstone's grave at Shupanga), that a second and even larger company has just commenced operations at Marameo on the same river. The products of the Mopea Company find a market almost entirely at Delagoa Bay and in the Transvaal.

Another product which is almost entirely neglected in British Central Africa is tobacco. This plant grows profusely in every native garden, and is not unknown as a weed in the coffee estates. Owing to the difficulties of curing for the European market it has not been received very favourably by experts in this country (the curing being radically wrong), but they state that, judging from the texture of the leaf, if properly cured it might fetch a very fancy price as cigar wrappers, as it is of such a naturally good quality. At present it is cultivated to any considerable extent only by the firm of Hynde and Stark, whose "Songani Brand" of pipe and cigarette tobaccos is favourably known not only locally but in South Africa, particularly Mashonaland

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and Matabeleland. Their pipe tobacco is prepared and packed similarly to the Boer tobacco of South Africa, and I have heard that in Southern Rhodesia it is preferred to the best Boer production. A member of the firm has assured me that it can be produced at a price, after earning an ample profit, which cuts lower than the South African. The firm is well satisfied with its venture in this line, and Mr. Hynde, who is editor of the *Central African Times*, strongly urges planters to embark on its cultivation. According to two tobacco planters from Borneo who visited the country in 1894, the Shiré valley is well suited for this product; but they were of opinion that the finer grades would never prove successful with our African labour, on account of their rough, careless handling of the delicate leaves, but with Indian or Chinese coolies we might very

Bird's-eye view of Magomero.

readily more than compete with Borneo. With millions starving in Northern India, a fine chance is here available for a far-seeing Government. By emigrating a few thousands of the starving Rajputs to British Central Africa, not only would India be benefited by the congestion of its inhabitants being in part relieved, but also this large land with its food for untold surplus millions. British Central Africa would be advantaged not only by increased trade as a consequence of a larger population, but the tobacco industry would have every chance of success when prosecuted by this desirable class of agricultural immigrant.

When Dr. Livingstone first visited British Central Africa he was much impressed by the great quantities of superior cotton grown by the natives for their own consumption. His first idea was that Central Africa should become a great cotton-producing country, large tracts of

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both high and low country being particularly suited to the industry. Of late years the cultivation has almost entirely died out, as, owing to the cheapness and superior finish of imported cloths, the native prefers these to his own manufacture. Some years ago several experimental gardens were grown by Europeans, but comparatively little permanent attention was given. A small sample was, however, sent to Liverpool brokers for report, and their opinion was that it was quite equal, if not superior, to the sea-island variety. Lancashire spends annually over £40,000,000 in purchasing raw cotton in the United States. Is it not a pity that this large sum should go outside the empire, when it could be readily conserved by cotton being grown here where land is cheap and abundant?

An industry which some day will prove of immense volume in British Central Africa will be the cultivation of the Sanseviera aloe. The fibre of this plant is of a fine long texture, superior to Manilla, and worth about £30 per ton in the London market. The cultivation is, I believe, of the simplest possible nature, and in addition it grows very freely in the bush. I saw it grown near Fort Lister in the Mlanje district, and according to the superintendent it required absolutely no attention. The process as described to me was simply to collect the plant in the bush, cut into lengths of about two feet, and dibble in regular rows. No clearing off of trees was necessary, nor hoeing of the ground, the plants themselves keeping the surrounding soil clear of weeds. In about two years from the time of planting out, it was expected that the first crop would be ready, and succeeding crops would come forward very quickly thereafter. The plant grows as a long, round, fleshy whip-handle, entirely free of leaves, ribbed, about two inches diameter and four feet long. Numerous stalks grow from one stool, and once this is set, the ripe growths are cut away just like rhubarb in this country. One immense advantage of this cultivation is that it appears to grow equally well in the most sterile or rich spots. On the top of rocks quite denuded of soil (and where it seems to get its sustenance entirely from the air, using the rocks simply as an anchorage) it has been found in great abundance. A company was formed some four years ago for the prosecution of this industry, possessing as one of its most valuable resources a patent machine invented by the manager, Mr. Foulkes. This machine, I have been informed, treats the aloe in a manner satisfactory for the London market. The cultivation of this plant is one peculiarly suitable to coffee planters as a bye-product. On every coffee estate there are areas of ground unsuitable for coffee, which might readily be utilised in growing the aloe. The only attention necessary would be the reaping of the crop, and its preparation for the market. If the expense from the plantation to London amounted to almost the resulting price, the planter would still possess a very valuable asset in the pulp of the aloe in which the fibre is enveloped. This pulp would undoubtedly form an excellent and cheap green manure to coffee. Did this industry give no greater nett return than permitted the coffee planter to apply green manure free to his coffee, its earnest prosecution would be quite warranted.

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A tropical product for which there has been an immense demand of late years is rubber. As previously stated the Landolphia rubber-vine grows freely in suitable localities of British Central Africa, and a very considerable tonnage has been exported chiefly from Lake Nyasa and the territories in the Lake Mweru district. Owing to the destructive method adopted in collecting the vine rubber, I do not think the trade will prove one of any permanency, and indeed the Landolphia has already become practically extinct in the Bandawe district, where it was very abundant only three years ago. With certain of the American rubber trees I, however, think the trade can be kept alive, and particularly fancy the South American varieties—Ceara and Mangobeira. The Ceara tree grows in perhaps the most sterile district of Brazil, almost from the

Country round Blantyre.

sea-level to an elevation of 5000 feet, should yet prove very suitable for the poorer parts of British Central Africa. As it is, it is no stranger to the country, but planters have been much disappointed with it, not on account of its growth, but product. Most articles on rubber cultivation describe the tapping of the *Hevea Braziliensis*, the rubber-tree of the Amazon valley, a tree quite distinct from the Ceara. Through lack of knowledge planters tried to tap the Ceara in the manner described for the *Hevea Braziliensis*, and of course failed. I have seen the Ceara treated at Mandala only, in the manner pursued in its native country, but unfortunately I left British Central Africa before learning results. Once the proper method of treating the tree is adopted, I have every hope of the success of the industry.

Other pursuits which would not bulk so large, but are quite warranted, are :—

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Cardamoms.—I have seen this plant in great quantities in the ravine of the Mloza stream at Mlanje, but am not aware that its cultivation has been attempted by Europeans. The fact that it grows wild, however, warrants the inference that it would be successful in suitable localities, and the splendid price which the fine Mysore article realises should prove an inducement to some enterprising planters.

Chillies also grow wild in the bush, and already certain planters find their cultivation as a catch-crop, and independently, fairly remunerative, the product fetching as much as 28s. to 32s. per cwt. in London. So far as I am aware, this chillie is grown from ordinary wild plant seed, and if the seed of approved varieties was imported undoubtedly higher prices would follow.

Arrowroot also does well in the Shiré Highlands, and the locally grown article competes freely with the ultra-fine production imported in air-tight tins. The Domasi branch, at Zomba, of the Church of Scotland Mission gives this plant special attention, and its product is well and favourably known locally.

Somewhat akin to arrowroot is the favourite farinaceous food, tapioca. The plant cassava, which produces this, is one of the commonest in British Central Africa, many of the tribes, particularly in Anguruland and on Lake Nyasa, using it as their principal food. Of late in a finer form it has been seen and appreciated in the Blantyre district, in the commissariat of Europeans. Immense quantities of this plant could be easily and cheaply produced, and form a new source of trade.

Some years ago tea seed was introduced, and I have seen a very nice patch of tea on the Lauderdale estate of that well-known and enterprising planter, Mr. John W. Moir. I have tasted Central Africa tea more than once and found it of fine flavour, and understand it has been well spoken of by experts. The cultivation of tea, however, I do not think will ever come to much, not only because the dry season is probably too long to admit of a paying number of flushes per annum, but also from the fact that (judging from the *Tropical Agriculturist*) this product is apparently already overproduced in India, Ceylon, etc. It has only been referred to in passing to show the capabilities of the country.

All the products above enumerated are little more than possibilities in the future of British Central Africa, and I now come to our chief export and main source of income, viz., coffee. Coffee was first tried commercially in the Shiré Highlands by the late Mr. John Buchanan, and his most sanguine hopes relative to it have been quite fulfilled. Coffee is to-day a success in the Shiré Highlands. Undoubtedly, in the past, planters have suffered serious losses and disappointments, but now that their lessons are learned, the reward is being reaped. The first plantations were opened on the Ceylon or Shadeless method, and under such conditions did fairly well for a time, but had a tendency to die back and go "shuck" owing to our drier climate. Planters are now shading their estates, principally with *Albizia Molucana* and local fig-trees, following in this respect the proved successful method of Mysore and Southern India. Already on more than one estate the beneficial

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effect of the new method is felt. One planter with possibly the largest area completely shaded by *A. Molucana* has informed me that the increase in size of the shade-grown coffee-bean is very marked in comparison with that grown fully exposed to the sun. In the London market, bold (*i.e.* large) coffee always fetches the highest price, other necessaries being in keeping. Apart from lack of shade, the only other enemy coffee-planters in British Central Africa have hitherto had to seriously contend against was spotted, light, and empty berry. The causes of this were formerly put down variously to lack of rain, sunburn, exhausted soil, etc. Only last June did Mr. K. J. Cameron of Namadzi, after exhaustive investigation and experiments, conclusively prove that a small spotted bug (previously thought to be the ladybird beetle and planter's friend) was

Light Bush.

the most deadly enemy of coffee. The majority of planters are enthusiastic over the discovery, and from their small number presented Mr. Cameron with a cheque for over £100 as recognition of his valuable contribution to coffee culture. Since the discovery the bug has received full attention, has been found on every coffee estate, and been destroyed in millions. Previous to this discovery, and despite spotted bean, etc., Nyasaland coffee has been classed amongst the finest in the world, and has received a price in accord on the London market. As high as 114s. per cwt. was paid for it there last year, and it is very favourably received by all connoisseurs. There were quite 6000 acres under cultivation, almost entirely confined to the Shiré Highlands. At Bandawe, on Lake Nyasa, two considerable estates were opened three years ago. It is too soon yet to know for a certainty how they will succeed, but judging

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from the fact that it is reported that in the Bandawe district both the soil and rainfall are superior to the greater part of the Shiré Highlands, it is anticipated that they will prove successful. Immense tracts of land in the Shiré Highlands and on Lake Nyasa are equally or more suitable to the cultivation of coffee than those now occupied, and it is confidently hoped that some day British Central Africa will become one of the greatest coffee-producing countries in the world.

An essential to the satisfactory cultivation of the foregoing products is an abundant and cheap labour-supply, and in this British Central Africa is particularly fortunate. The natives are, on the whole, docile, intelligent, and willing, and thousands of them have as yet never worked with Europeans. Their eagerness to possess cloth, however, brings them

Coffee Planter's Bungalow.

into the settlements in increasing numbers. Under normal conditions British Central Africa is particularly fortunate in its cheap and abundant labour-supply, but as it is, abnormal circumstances obtain, viz., that a province of the British Empire, which has proved for a number of years the certain success of its industries, is without the inestimable advantage of a railway.

The Shiré Highlands is in the unique position of being the key to Central Africa, not only British but German and Portuguese, and the eastern section of the Congo Free State. By the splendid waterways of the Zambezi and Shiré rivers, and Lakes Nyasa and Tanganyika, the natural road is found to the absolute interior of Africa. Dividing these sections of natural road are the Murchison cataracts on the Shiré and the stretch of country (about 200 miles)

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between Lakes Nyasa and Tanganyika. Were these two sections bridged by railways, the impetus to trade in British Central Africa could not readily be gauged. As it is, the route through the Shiré Highlands is the one almost entirely used for transporting goods for the eastern division of the Congo Free State, German and Portuguese Nyasaland, and all British Central Africa. Practically the entire transport past the Murchison cataracts for the interior, as also of goods for planters and others in the Shiré Highlands, and of all exports, is done by the primitive means of native carriers. This method is a most ruinous one on the native labour of the country, as quite three-fourths of the supply is employed carrying loads, with the consequence that planters are frequently hard pressed for labour in the wet season. Owing to the racking work

Blantyre Church.

of carrying loads, natives much prefer plantation employment at an equal pay, and the transport companies are compelled to offer them the inducement of superior remuneration, in order to get their work done. A transport worker gets about a half more pay than a plantation worker. The planters in turn have been compelled to raise wages, and so the game goes on. As a consequence of this competition for labour the natural expansion of the coffee industry is prevented, and until such time as a railway is built I much fear the country will be at a standstill. A low estimate of the coffee crop to be exported this next dry season places it at 1000 tons. Latest papers from Africa report a block in the land transport of goods on the Lower Shiré, and a heavy tonnage afloat and ashore at Chindé. All these goods have got to be carried some time to their destinations or to the Upper Shiré, and this by carriers only, as

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the bullock transport of the country is quite a negligible quantity. The Europeans of British Central Africa are not an over-ambitious folk like (possibly) their southern kinsmen in the matter of railways. They do not as yet even suggest the desirableness of the long railway between Nyasa and Tanganyika, but feel keenly the need of one in the Shiré Highlands. For some years an agitation has been carried on for the building of a railway from Chiromo at the junction of the Ruo and Shiré rivers to the Highlands, and thence to the river above the Murchison cataracts, or on to Lake Nyasa near Fort Johnston. The necessity of this railway is endorsed by H.M. Commissioner in his last report to the Government. The report was duly issued as a Blue-Book, and Mr Sharpe therein says :—

"As already stated in the previous annual reports, the British Central Africa Protectorate is suffering, and its development delayed, for the want of a railway from Chiromo, the head of navigation on the Shiré Highlands and thence to Lake Nyasa."

If this railway were built, it would throw free for more natural labour than acting as human beasts of burden, quite 20,000 people, coffee and other industries would receive a great impetus, and the Shiré Highlands would become of great strategic value, from an Imperial point of view. This agitation has now taken the concrete form of a Petition from the British Central African Chamber of Commerce to Lord Salisbury, praying the Government to build the railway, and giving figures showing that the expenditure of the capital necessary is warranted. The tonnage of imports and exports could now pay a fair return, rates of transport being lower than now. Many influential gentlemen in this country, as also several Chambers of Commerce, have signed copies of the Petition, and the British Central African Chamber of Commerce hopes to secure many more. Mr. Bruce-Low of 23 York Place, Edinburgh, who has taken a warm interest in the matter, has a number of printed copies of the Petition, and will be pleased to supply them to interested parties.

I have been given to understand that the Government views the object favourably, and it is hoped that once the present war is brought to a satisfactory conclusion, the construction of the railway will be taken up—detailed estimates and surveys having already been lodged in the Foreign Office.

Once the railway across the Shiré Highlands is completed, a naturally rich country will be able to fully show its capabilities, and the great commercial possibilities enumerated in the foregoing notes will of a certainty become actualities.

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PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meeting of Council.

At a meeting of Council held on 22nd March, the undermentioned gentlemen were elected Members of the Society, viz. :—

George W. Elmslie.	Angus Sutherland.
D. Campbell M'Kellar.	F. Melson Wingate.

At the same meeting a Resolution was unanimously passed expressing the Council's sense of the loss sustained by the Society through the death of Mr. James Currie, who had acted as one of the Society's Trustees from the date of its foundation.

Honorary Diplomas of Fellowship were conferred on Mr. H. O. Forbes, LL.D., and the Rev. Robert Laws, D.D.

It was decided that the Society should take part in the Congress of Economic and Commercial Geography to be held in Paris between the 27th and 31st August.

Meetings held in March.

On the 8th March, the Rev. Dr. Laws, of the Livingstonia Mission, addressed the Society in Edinburgh on the Geography of Central Africa.

On the 22nd, Mr. W. S. Bruce read a paper on "Spitzbergen—Voyages with H.S.H. the Prince of Monaco"; and on this occasion the President of the Society, who occupied the Chair, made an important announcement. Sir John Murray said that Mr. Bruce had informed him that, as a result of some interviews with wealthy Scotsmen, he had hopes of being able to raise a sum of £35,000 or £40,000, in order to fit out a second ship from Great Britain to take part with other expeditions in the exploration of the Antarctic. He hoped that Mr. Bruce would be successful, and believed he could assure him, on the part of this Society—and indeed on the part of all the Scientific Societies of Scotland—that he would receive any patronage, encouragement and assistance they might be able to give. Mr. Bruce repeated his address to the Aberdeen Branch on the 26th, and to the Glasgow Branch on the 29th. On the last-named date, the Society in Edinburgh assembled to hear Dr. H. R. Mill's Study in Local Geography."

Meetings fixed for April and May.

On the 26th May Mr. Nelson Annandale will address the Society in Edinburgh on his recent travels in Siamese Malay States; he will visit the Glasgow Branch on the following day.

On the 23rd May Mr. Arthur H. Sharp, and, it is hoped, Mr. E. S. Grogan, will read papers before the Society in Edinburgh on their journey from the Cape to Cairo, by way of Uganda, Tanganyika and the Nile Valley. This will be the last meeting of the Session.

GEOGRAPHICAL NOTES.

AFRICA.

The Development of the Eastern Sudan.—On the 10th of January the first through train arrived at Khartum. According to Lord Cromer, in his *Report on Egypt for* 1898, it is the intention of the Government to continue the railway

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from Khartum up the Bahr-el-Azrak to Abu Haraz and on to Kassala by way of Gadarif and Mugatta. From Kassala it will proceed to the coast at Sawakin or some other port. On the 20th of April of last year Colonel C. S. Parsons gave a lecture on the Eastern Sudan at a meeting of the Royal Artillery Institute. As regards the climate, he said that "it is similar to that of the Sudan generally—excessively hot by day with a breeze by night, rendering sleep possible; it is not so on the Red Sea, where at places like Suakin and Massowah the nights during July, August, and part of September are almost unbearable. The nearest sanatorium I know of is in Eritrea, at Asmara [some 240 miles from Kasala], 8000 feet above the sea, and at Keren. The climate of this part of Eritrea is very like the climate of Switzerland." In the course of the discussion that followed, Major Count Gleichen, who prepared the *Handbook of the Sudan* (1898) for the Intelligence Division of the War Office, requested the views of Colonel Parsons on the possibility of the above scheme for the railway, and the extent to which it would develop the country. "With regard to the future railway system in the Eastern Sudan," said Colonel Parsons, "the line that suggests itself is the line up the Atbara from Berber to Adarama, and from Adarama to Suakin and Kassala. Between Adarama and Suakin there are no engineering difficulties till north-east of Sinkat, when there is rather a big drop of about 3000 feet into the Suakin plain. The alternative route from Suakin to Berber is undoubtedly through its entire length a difficult line to construct. The line to Kassala from Adarama is easy, running along the banks of the Atbara to Goz Rejeb, and thence branching to Kassala, following the old telegraph line. The main line could be continued from Goz Rejeb to Mugatta and Gedarif along a level plain. By connecting Kassala and Suakin *viâ* Adarama a great difficulty in connection with the Khor Baraka is avoided, as, owing to the number of transverse khors running from east and west into it, the amount of expensive bridging required in connection with a railway running north and south along the Khor Baraka would be considerable. I think the Eastern Sudan railway would pay eventually when trade is developed. Gedarif is the granary of the Eastern Sudan; it could provide grain for local requirements, and still have a large surplus for exportation. Excepting in durra, gum, ivory, and feathers, there is little trade; sheep and cattle are of poor description and in no great quantities. Cotton stuffs and Manchester goods are being imported by the Greeks and sold at large profits to the natives in December last. There are no minerals that I have heard of, not even about Suakin; the only district where minerals are likely to be found is in the Beni Shungel country, far south of Gedarif on the Abyssinian frontiers."—*Proceedings of the Royal Artillery Institute for* 1899, p. 284.

This is an entirely new suggestion regarding the best route for a railway. It is to be noted, however, that it follows a caravan route between Adarama and Suakin. In considering this problem it is necessary to bear in mind that there is a Khor Langheb as distinct from a Khor Baraka route between the coast and Kassala. With regard to the suitability of these latter routes for a railway from Tokar to Kasala, Count Gleichen says in the *Report on the Sudan*, which he revised for 1898:—"A railway could be easily laid for the first 67 and the last 58 miles, but to lay a line along the remainder of the route would entail an immense amount of labour. The east side of the Khor Baraka is, I consider, out of the question, as where the hills do not run down and line its bank, the water at flood time spreads, according to the guide's report, to the foot of the hills. The west bank is more open, but the ground is so cut up with small khors and watercourses so undulating as to entail in my opinion too much labour to level it. The general opinion amongst the guides, etc., was that the route west of Tamrin, round west of the Shaba range of hills, and thence joining the old telegraph line, is much more

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level and suitable, and they say that water could be found in plenty."—*Report on the Nile and Country between Dongola, Suakin, Kassala, and Omdurman*, second edition, 1898, p. 286.) This route last mentioned and deemed most suitable is the Khor Langheb route. It has been adopted in laying the telegraph line from Tokar to Kassala.

The Future of the Masai.—One of the problems in British East Africa is how to utilise the several native tribes. The Masai are a fighting race, who have looked down upon industrial pursuits, and many have doubted any likelihood of their settling down to a peaceful life. When Colonel Macdonald finally led his expedition to the Upper Nile, he decided to make a trial of some Masai, and his report regarding them is full of promise for their economic future. "The Masai had done very good service," says Colonel Macdonald, "and I felt that not only should the terms of their agreement be adhered to as regards cattle from the point of view of good faith, but also because I hoped that the considerate treatment they had met with at our hands might encourage the Masai to again take service with Europeans, and thus find a legitimate outlet for their energy instead of confining themselves to cattle-raiding, which was sure to bring them into conflict with the Administration sooner or later. I believe this is the first time a body of Masai have been employed with Europeans for such a lengthy period, a year and a half, and I am happy to say that our experiment in thus employing them was entirely successful. They proved willing and obedient, submitted to the restraints of discipline without murmuring, and proved a very useful adjunct to the caravan. When paid off at Kikuyu, they were fully satisfied, and when they said good-bye on leaving for their kraals, told us that the service of the European actually paid better than cattle-raiding." It is true that the spirit of the Masai had been much broken in recent years by the great loss of cattle among them through the plague, but the memory of their warlike past remained, and Colonel Macdonald is to be congratulated on the foresight which initiated this experiment and the success which attended it.

The Sudd of the Nile.—It is expected that the sudd will be entirely cleared by May, and that there will then be clear water between Omdurman and Uganda. A three-weekly service of steamers will then be begun, and the Uganda Protectorate will be reached in about twenty days from Omdurman, or four weeks from London. A reconnaissance of the river was begun last September by Captain Moreton Gage, commanding Fort Berkeley, and Dr Milne, principal medical officer of the Upper Nile District. Leaving Fort Berkeley for the north in a steam launch, the expedition worked hard for five months before they reached Major Peake. At times progress was only at the rate of 300 yards a day, and during three months the officers only set foot once on dry land. The sudd was found to begin at Shambe, but navigation was possible for 200 miles north of that point. Then there occurred stretches of the river blocked with sudd twelve feet deep, and so compact that it would bear the weight of an elephant, with here and there clear spaces. Major Peake's expedition, with which Captain Gage joined in January, consisted of four gunboats, with four hundred Dervish prisoners engaged in cutting the sudd. A gunboat was sent ahead with a hundred and fifty Dervishes, and the sudd was cut into blocks of fifteen yards square. At each corner of these telegraph poles were driven into the mass, and the whole was bound with steel hawsers. The steamer would then go astern at full speed and wrench out the roots, the mass afterwards drifting away. Even in ancient times the Nile has been subject to this periodic blocking by vegetation. The absence of well-defined banks

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in the upper part of the Nile basin allows the river to spread into a vast marsh, so that there is little current, and enormous quantities of water are lost by evaporation. A permanent removal of the difficulty, according to Mr. Willcocks, can only be secured by the abundant planting of willows and poplars, leaving only a narrow course for the river. These would soon consolidate the banks, and thus cause sufficient current to clear away the grass, papyrus, and ambatch which from time to time block up the river.

The German West Bank of the Victoria Nyanza.—Captain Hermann describes the geology of the country west of the lake in the *Mitth. aus den Deutschen Schutzgebieten*, Bd. xii. Heft 3. A plateau covers the space between the Victoria, Albert and Albert Edward Nyanza and the Kivu lake, falling steeply on both sides down to 330 or 1300 feet, and forms a marked step in the East African terrace formation. It is composed of quartzite clay, clay-shales and slates—the quartzite being uppermost. When the granite region to the south was already above the water, this plateau was still submerged, and layers of clay were laid down upon it. The clay in part hardened into shales and slates, the hardest and softest strata often alternating from snow-white kaolin to the hardest black roofing slate. On these strata quartzite was deposited in a few thick layers, 300 to 1300 feet in thickness. After these rocks had been laid down on the sea bottom, they were raised above the surface, and at the same time faulted and fissured. This is the period in which probably the whole terrace system came into existence, the great troughs, and the volcanoes on their edges. This great movement must have taken the same direction everywhere, for all the strata, troughs, and faults strike north-north-east to south-south-west. Of the original elevated plateau only individual blocks remained in position, dipping steeply east, south, and west, for even then the outlines of the present sections had been defined by step faults.

The plateau is divided in general into a number of parallel long rectangular blocks, separated by troughs which are occupied by rivers, swamps, or chains of lakes. The first block consists of the islands from Bukerebe to Maissome, all which are connected below water, and this is succeeded by the first trough lying between the islands and the west bank of the Victoria Nyanza. The second block is the steep slope from the mouth of the Kagera and the southern border of Ussuwi, the difference of level on the east being 330 to 900 feet. The second trough is formed by the valley of the Ngons river and those of the Rwiga and Nyarumbugu. Between them the second block merges into the third. The third block falls steeply to the east and north and south, and passes into irregular hill country. The third trough is marked by the Muisa river, the Kamakara and Urigi lakes and their southern affluents. The fourth block extends in a continuous barrier from Bugara on the north (south of the Kagera) to the southern boundary of Uyagoma, and is skirted on the west by the lakes and swamps of the Kagera valley, while beyond is the fifth block, in Ruanda, extending to the great central African fissure.

The Victoria Nyanza is subject to three variations of level. Like all East Africa, it is on the whole drying up. Secondly, according to the natives, it rises and falls in a period of eighteen to twenty-five years, the difference of level being, perhaps, about five feet. Thirdly, it rises during the rainy season and falls after it, the difference being 16 to 20 inches. It may be assumed that the water at one time stood so high that the troughs, including the Kagera valley, were arms of the lake. The first trough, between the islands and the bank is still open water, but, by further contraction of the lake, would be converted into a valley. Whether another step exists to the east might be ascertained by sounding.

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Exploration in the Sobat Region.—The *Geographical Journal* publishes a letter from Major H. H. Austin, who is accompanied by Lieutenant Bright, bearing date December 20, 1899:—"As during the last few weeks, during our journey up the Nile, we have been able to fix some points with tolerable accuracy, some of the results we have obtained may be of interest to the Geographical Society. We have now been able to fix the true position of Omdurman by telegraph with Cairo. The point taken was the Khalifa's house, near the Mahdi's tomb. . . . The position of Omdurman now fixed, viz., long. E. 32° 29′ 42·5″, and lat. N. 15° 38′ 15″, differs very materially from the previously accepted position of Khartum, which is only some two or three miles distant, near the junction of the White and Blue Niles. . . . As I have really good instruments and watches with me on this trip, I hope to get some reliable work done between the Sobat and Lake Rudolf, which I am now making for, to join on with my old work done last year from the Mombasa end. If successful, we shall have a thorough survey done practically from Mombasa to Omdurman. I cannot yet say definitely what route Bright and I will follow until we come in contact with difficulties ahead; but, roughly, we propose following the Ajouba down from its junction with the Pibor to near its source in the Abyssinian hills, when we shall strike south to Lake Rudolf. On the return journey we hope to investigate another route north, along the base of the Abyssinian plateau to Gumbila or Gore, on the Baro river, which we propose following down to Nasser. If all goes well we hope to be back at Nasser early in June, and home perhaps a month later. Lieuts. Gwynn and Jackson, R.E., are working up the Blue Nile from Omdurman, and will join on to the southern portion of the survey to be carried out by me, probably both at Gumbila and Nasser, so that portion of the Sudan should be accurately known. Telegraphic positions of both Wad Medani and Roseires on the Blue Nile have been fixed; but I have not the results, so am unable to give them to you. It is an extraordinary low Nile this year, and the waters of all the rivers are as low as usually two months later in the year. It is not a bad thing as far as I am concerned, as I hope to be able to cross large areas shown as swamps, provided that the tall rank grass has been burnt by the natives. We shall probably traverse country previously visited by both Bottego and Wellby, so I fear we shall not be able to make any new discoveries like they did, but still I hope will be able to fill some blanks still existing in those regions. It may be of interest to you to know the strength of the party with Bright and me. We have an escort of 22 men of the 11th Soudanese Battalion under a native officer, and 24 Jehadin, or ex-dervishes, also armed, in charge of the transport animals. We muster about 50 blacks all told, including servants, besides ourselves. For transport we have 120 donkeys, 7 camels, and 10 mules, as we must be capable of carrying at least two months supplies of food for the whole column in this inhospitable region."

From Fort Jameson to the Tanganyika Plateau.—A record of his journey of 615 miles, in the months of April to June of last year, is given by Mr. Robert Codrington, Deputy-Administrator of Northern Rhodesia, in the *Geographical Journal* of last month. From Fort Jameson he passed through a well wooded and watered country to Msoro, where there is a trading-station of the North Charterland Exploration Company, doing a small trade in ivory and wax with the many Senga villages in the neighbourhood. Crossing the Loanga river, and climbing the Muchinga range, he passed through an uninhabited country with many streams, preserving an elevation of about 5000 feet, to Serenje; thence through a level country with open plains alternating with light forest trees and occasional stony kopjes, where water was plentiful and good but the population

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small, to the present village of Chitambo. The latter, who is an intelligent man of about thirty years, presented Mr. Codrington with a document left by the Belgian expedition, which placed in position the bronze plate sent out by Mrs. Bruce to mark the place of Livingstone's death. This document contained the formal promise of the chiefs to preserve the monument for ever. The plate was stolen in 1892 by a slaving expedition. Mr. Codrington cut down the tree on which the name of Livingtone and the date of his death were carved, and removed the part carrying the inscription to Fife, where it was handed over to the representatives of the London Missionary Society. The Chambezi was reached at Kabinga. The river is here two miles wide and 19 feet deep. The author travelled twenty-six miles up the river, and found the average width to be about a mile and a half, and depth about 15 feet. There are very many islands, and the banks are steep and well-wooded. The population is considerable, but is scattered on the islands; there are hardly any paths, the natives travelling from one village to another by canoes. Passing through the Awemba country, formerly the scene of continual raiding and great oppression, but now tranquillised by European rule, Mr. Codrington reached the Tanganyika plateau. His paper is accompanied by a map.

Mr. J. E. S. Moore at Tanganyika.—Sir John Kirk has received the following letter from the leader of the Tanganyika expedition:—"I have just returned from the north end of Lake Tanganyika, where I have left the loads, etc., and where I am glad to be able to tell you that I have found it quite possible to go north over the tracks originally arranged. I am also glad to be able to tell you that Fergusson has got a lot of observations which show Tanganyika to be a long way out in the old maps in places. We have also obtained a number of new fish and other forms, which will certainly be interesting from the point of view of the origin of the marine forms which Tanganyika possesses." Mr. Fergusson publishes his map with a communication in the present number of the *Geographical Journal*.

The Madagascar Railway.—The difficulties and expense of transport in Madagascar are enormous. General Gallieni began the construction of a road from Tamatave and Majunga to Antananarivo four years ago, but it is not yet finished. Recently the colonial administration has sanctioned a loan of 60 million francs for the purpose of a railway from the port to the capital, among other public works. The work will be undertaken in sections, under the direction of Colonel Roques.

The Occupation of In Salah.—In Salah, which has for long constituted a centre of anti-French agitation, has been occupied by M. Flamand. The region of Touat comprises three distinct groups of oases. In the north, Gurara and Aouguerout; in the south-east, Tidikelt, with In Salah as its centre; and in the south-west, Touat proper, with Taourirt and Tamentit as its centres. In Salah itself contains about 230,000 palms and 4500 inhabitants. The place was taken in January, reinforcements were sent up, and it is intended to maintain an effective occupation. It is on the caravan route from Marocco to Timbuctoo and to Fezzan, and is regarded as a strategic and commercial key to the Sahara.

Dr. Richard Kandt at Kivu and Tanganyika.—From the valley of Rusisi, which joins these lakes, Dr. Kandt reached Kivu in March of last year, followed the west shore of the lake, and, after passing through the countries of independent sultans, came within two days' march of Albert-Edward. Returning, he followed the eastern shore, and finds that the situation and the form of the lake are both different from those mapped. A bold island rises from the lake, and the Rusisi

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has its exit south of the island. In the north, near to the Virunga mountains, Dr. Kandt found a large plain of lava.

The Foureau Lamy Expedition.—M. Foureau, about whom many alarming reports had reached Europe, has succeeded in crossing the Sahara to Zinder, which is an important meeting-place for caravans for Marocco and Tripoli, and had already been occupied by Lieut. Pallier and the remains of the ill-omened Voulet-Chanoine expedition. He passed through Aïr, following the route taken by Richardson in 1850, and Von Bary in 1877. Attempting to proceed to Lake Chad, he was stopped by a mutiny among the natives. The Anglo-French boundary was found to coincide with the northern limit of cultivable land. The last villages and wells lay just at the frontier.

Captain Prince in Merere's Country.—This traveller gives an account of a recent journey through the upper Ruaha valley in the *Deutches Kolonialblatt* of November 1, 1899. The plain of the Great Ruaha is level and treeless, limited only by the horizon, and containing vast herds of zebras, for which Captain Prince thinks this district should form a reserve, and antelopes. He ascended the river up to its junction with the Bavali and Kimara, through a monotonous yellow plain, in great heat. Farther up in the district of Donjera, he entered a more fertile country, and passed through Utengule, which was being rebuilt by Merere, to the Usafa escarpment, which forms the frontier of Merere's country. The pass by which Usafa was reached is an easy one, and should form a good route from Nyasa to Rukwa and Tanganyika. Captain Prince met everywhere with the ravages of smallpox, against which preventive inoculation is now being carried out on a large scale.

Boundaries of North-Eastern Rhodesia.—An order in Council, of January 29, 1900, fixes these as follows:—On the west the Congo Free State and Barotziland-North-Western Rhodesia (the latter comprising the western portion of the British territory defined by a previous order in council). On the south the Kafukwe and the Zambesi down to the mouth of the Loangwa; the latter northwards to 15° S.; and the Anglo-Portuguese boundary to the frontier of the British Central Africa Protectorate. On the east the last-named frontier; and on the north the Anglo-German frontier, the south shore of Tanganyika, and the southern frontier of the Congo Free State to Lake Mweru, including the island of Kilwa in the British sphere.

Dr. Carl Peters on Macombe's Country.—At a meeting of the Society of Arts on the 7th of last month, Dr. Peters communicated a report of his investigations into the history and mineral and other resources of the Portuguese country south of the Zambesi. He identifies the present Fura with the Ophir of the ancients, and regards the gold as payable. He has secured a trading concession from Macombe, and expects that the country will have a considerable commercial future.

Congo Free State.—On the completion of the railway from Matadi to Stanley Pool, the Belgians have begun a line from Boma, on the right bank of the lower Congo, to Buku-Dungu, on the French frontier, crossing the Mapumbe. Of the 200 kilomètres, about 50 are finished.

The Ivory Coast.—The French Colonial Administration has adopted the railway and harbour scheme drafted by M. Houdaille. The port will be established on the bay of Abidjean, half-way between Jackville and Grand-Bassam, and will admit vessels up to 3000 tons. The harbour work will be begun in the present year, but the railway will not be begun until 1902.

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ASIA.

Baron von Oppenheim in Syria.—This archæologist, who is an attaché of the German consulate at Cairo, has made interesting discoveries in Syria and neighbouring countries. His route was from Damascus to the Tell Nibi Mindu and thence to Homs by the eastern shore of the lake; across the Nosairi mountains to Masgaf and Hamah, eastward to Salamija and thence to Aleppo. Baron von Oppenheim has discovered several cities of the Christian-Greek period, the houses and forts still not wholly ruined, and containing ornamental carving and inscriptions. He hopes to find the remains of old civilisations in that part of Mesopotamia east and west of the Belik which is at present unknown, and to make his way to Konia and Constantinople by the line of the future Bagdad railway.

A Persian Road.—The road from Resht to Teheran, designed by Russian engineers, has recently been opened, and wheeled vehicles can now go from the Caspian to the capital. Although Resht is very unhealthy it is growing rapidly, being the centre of an increasing trade and of a fertile country, where rice and silk are largely cultivated.

Travels of M. Klementz in Western Mongolia.—M. Klementz communicates to the *Bulletin* of the Paris Geographical Society, 1899, Pt. 3, a short account of all his journeys down to 1897. His work is chiefly geological and physiographical. He has thrown new light on the regions of the upper Obi and Yenisei; on the geology of the Sayan range, which is formed of two great folds—the northern part consisting of talcous, chloritic, and clayey schists, overspread by limestones, while in the south a clayey conglomerate and schists with fossils, probably of Cambrian age are met with; on the Khangai and Southern Altai systems, the former of which, though of considerable altitude, includes no important peaks except the Otkhon Tengri, and consists of a series of folds falling abruptly to the south, while the valley separating it from the Altai has the form of a trench; the range contains eruptive formations and some extinct volcanoes; the Altai range is formed of a series of folds, inclined towards the south, the dip being abrupt in the Dzungarian Gobi.

Potanin on the Border of China and Tibet.—An account of the latest journey of this traveller in Western China, in 1893, has recently appeared in the *Izvestia* of the Imperial Russian Geographical Society, and a report of it is given in the *Geographical Journal* for last month. "From Pekin, the route *vid* Singan-fu across the Tsinling mountains to Cheng-tu was taken, the journey being continued by the usual route to Tatsien-lu. Here the real work of the expedition began, the ground chosen being the almost unknown mountain region to the north of the frontier post just named. Ascending the Tung-po-ho, a tributary of the Ta-tsien-lu river, past several Tibetan villages, Potanin crossed the Ta-pao Shan by a pass some 14,000 feet high, and proceeded down a valley to the town of Rumi-jangu, on the bank of the Takin-ho, of Great Gold river, which, joining the Siao-kin-ho, or Little Gold river, forms the Tatu-ho of Chinese maps. The district is known to the Chinese as Kin-chuan, or the "gold valleys." In this region the Russian party had been preceded, in 1891, by the Austrian traveller Rosthorn, the first account of whose journey appeared in the *Mitteilungen* of the Vienna Geographical Society for 1895. The 'gold valleys' were also visited in 1896 by members of the Lyonese Commercial Mission. Potanin continued his journey across the divide at the source of the Little Gold river, and passed through the Miao-tz country to Li-fan-fu, visited by Captain Gill and Mrs. Bishop."

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Railways in China.—There is a double line from Pekin to Tientsin and to Shan-Hai (480 kilomètres), and a short line from Shanghai to Wusung. Among the many proposed lines only four are now being constructed :—(1) Pekin to Hankow (1120 kilomètres) belonging to a Franco-Belgian company ; eighty-eight kilomètres from Pekin are finished, and it is expected that the line will be completed this summer as far as Pow-ting. (2) Shan-Hai to Niu-chwang (480 kilomètres), administered by the Chinese but backed by an English company, will be open this summer as far as Kinhchow, and will serve the new port of Ching-Wan ; when finished it will take the winter traffic of Manchuria which is icebound for five months. (3) Stretensk to Vladivostok, which is merely the portion of the Trans-Siberian railway passing through Chinese Manchuria ; and (4) the Russo-Manchurian line, also constructed by the Russian Government, being a branch to Talienwan and Port Arthur from the last-mentioned line. Besides the above, concessions for thirteen lines have been secured by foreign companies, but work on them has not yet begun.

Proposed Railway to China.—At the meeting of the Association of Chambers of Commerce last month, Mr. H. F. Hibbert moved the following resolution :—"That, seeing a practicable route has been discovered between Burma and the upper reaches of the Yang-tse, Her Majesty's Government be asked either to undertake the construction of a railway from Kunlon Ferry through Yun-nan to Szu-chuan, or take steps to ensure that British promoters who may take the work in hand shall have reasonable security for the capital which they may invest in it." Mr. Joseph Walton, M.P., in seconding, described his experiences in the far East during the eight months which he spent there in studying the political and commercial situation. The motion was adopted.

Kruyt's Journey in Celebes.—Dr. A. C. Kruy cently crossed the eastern peninsula of Celebes, from the gulf of Tomini to the gulf of Tomori and back. With Dr. N. Adriani, he ascended the river La, which is named Tampira on the maps, explored its tributaries, and discovered the lake which was reported by Sarasin under the name of Lowo, finding it to be merely an area of flooded grassland from two to three feet deep in the dry season, lying south of the La, with which it is connected at its eastern end in the rainy season.

The Dutch Deep-Sea Expedition to the Malay Archipelago.—This expedition has undertaken wide researches in the Macassar strait, Celebes sea, Molucca strait, Halmahera sea, and Ceram sea, working up the zoology, soundings, temperature, etc., as well as making surveys of coasts and harbours. Among other results it has proved that no deep channel north of Bali and Lombok exists in sufficiently continuous form to have the effect attributed to it by Wallace in the determination of the fauna of these islands.

AMERICA.

The Southern Coast of Alaska.—Last summer the steamer *George W. Elder* took out an expedition under the leadership of Professor W. H. Brewer of Yale University. The vessel skirted the southern coast of Alaska to Unalaska island, and then ran to Port Clarence in Bering Strait. No systematic exploration was attempted, but parties were landed here and there to survey special localities, to measure the heights of mountains, and to examine glaciers, locating their fronts for future comparison. The most important topographical discovery was made in Prince William Sound, where a fiord, 15 miles long, and containing five

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discharging glaciers, was named after Mr. Harriman, who had provided the funds for the expedition.

The entire coast of Alaska and its islands, from Dixon Entrance to the Aleutian islands, is mountainous, rising abruptly from the sea to summits ranging from 3000 to 18,000 feet in height. The most prominent fact connected with this coast is that its features are almost wholly the product of glacial action. Not only are its fiords the abandoned channels of glaciers, but the hills and mountains have been shaped by them, and their retreat has been so recent that atmospheric agents have not had time to modify the surface. The fiords present the characteristic cross section of glacier-cut gorges, with steep walls and a nearly level bottom—the common U shape. The floors of the branch gorges are at a higher level than the main fiord, opening upon it at altitudes of hundreds or even thousands of feet above it. This phenomenon, so universal and so striking, has only recently been noticed. When these branch gorges were formed the ice in them must have been on the same level as in the main gorge, for if the levels were for any length of time different, the ice would cut down the side gorge, or flow out of it to the lower level. The recession of the glaciers must have been rapid, or the side gorges would be cut down lower.

The glaciers may be grouped into two classes—those which reach the sea and discharge icebergs, and those which do not. Of the former the expedition examined 22, while of the latter there are many hundreds, from the Great Malaspina, a lake of ice 60 miles by 30, down to little streams two or three miles in length flowing down the mountain gorges. The glaciers are, with few exceptions, receding. In the case of the Muir glacier it has been proved by actual measurement that the recession in the past twenty years has been two miles, while the level of its surface has at the same time been reduced 300 feet.

Prince William Sound proved a very fertile field for exploration. Port Wells on the north-west coast of the sound, represented on charts as a shallow bay, penetrates northward into the land to a distance of forty miles. It divides near the head into two branches, each containing a glacier, named by the expedition the Yale and Harvard. Twenty miles above the mouth Port Wells is joined by a western branch, which some five miles up is contracted to a narrow strait by a huge glacier; beyond is the magnificent Harriman fiord.

The coast of Alaska is covered with forests, from Portland Canal nearly to the island of Kadiak, except in the neighbourhood of glaciers. The timber line runs low, ranging from 3000 feet in the south-east to nearly sea-level in Prince William Sound. The trees are mainly the Sitka spruce, with some cedar in the east, giving place westward and upward to hemlock. The Alaskan peninsula and the Aleutian islands are treeless, and covered with grasses, willows, and alder.—*Bulletin of the Am. Geogr. Soc.*, No. 4, 1899.

Dr. Carl Sapper's Researches in Nicaragua and Costa Rica.—The elucidation of the geology of Central Southern America was the object of a journey of which Dr. Sapper gives a report in the *Verhandlungen* of the Berlin Geographical Society for November 10, 1899. But there are also new topographical determinations, involving the correcting of existing maps, especially in the department of Cheritales in Nicaragua, the Nicoya peninsula, and other parts of Costa Rica; and the region of the upper Estrella and Chiriqui. There are also ethnological observations, and others on the climate and plant associations of these regions.

A New Port for Bolivia.—Having no seaboard of her own, the Republic of Bolivia is dependent on the ports of her neighbours, Brazil, Peru, Chili, and the Argentine

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Republic, in her commercial relations with the world. According to the Board of Trade Journal, the Consul at Para reports that a new port has been opened at the beginning of this year on one of the principal tributaries of the Amazon river. This port is named Puerto Alonso. It is situated on the river Acré, or Aquiry, one of the head-waters of the river Purús, and will have some importance as it will be the outlet of a district rich in rubber. Formerly Bolivian produce was shipped from the port of Villa Bella on the river Madeira. It did not give satisfaction, however, because the Madeira offers many obstructions to navigation. On the other hand, the rivers Purús and Acré are easily navigated at high water.

A New Railway in Brazil.—A railway is to be built from San Antonio di Madeira to Marmore, some 100 miles in length, to avoid the falls of the Madeira river. The Madeira river, which enters the Amazon some 80 miles east of the mouth of the Rio Negro, is deep, and ocean-going vessels can navigate it. It is navigable for 1204 miles, and is the natural exit for Bolivian produce.

An Unknown Mammal in Patagonia.—For the past twelve months or more notices have been published in scientific periodicals of an as yet unknown quadruped that has been supposed to be still living in Patagonia. Sr. Rodolfo Hauthal describes, in the *Revista del Museo de la Plata*, Tomo ix., the circumstances under which relics of this animal have been found. A party of travellers in January 1895 came upon a large cavern about four miles north-east of Porto Consuelo in Last Hope Inlet, and on a mound in the forepart of the cavern found a piece of hide 5 feet long by 28 to 30 inches broad. The head and extremities seem to have been cut off. The hair was reddish, coarse, and one to two inches long, and to the inside of the skin many small bones adhered. Doctor Otto Nordenskiöld found here another piece of skin and a claw, and Dr. Moreno sent a piece of hide to London, where it was the subject of discussion at the Zoological Society (*Proceedings*, Part i. 1899). Dr. Hauthal met Drs. E. Nordenskiöld and Borge at Porto Consuelo last April, and after seeing the relics they had collected, determined to examine the cave himself. From many indications he concluded that the great cavern, as well as another a couple of miles distant, had been inhabited by man, and Sr. S. Roth affirms that the hide belonged not to a *Mylodon* or *Neomylodon*, as Dr. Ameghino has named it, but to a *Grypotherium*, an animal which was domesticated by prehistoric man, and therefore he has given it the name *Grypotherium domesticum*. Sr. Lehmann-Nitsche suggests, however, that the animal was wild, but kept for some time a prisoner in the cavern. Sr. Hauthal suggests that the cave was inhabited by the same people who erected a tomb on the Cerro Guido, 3600 feet high, some 40 miles to the north; in both fragments of a black volcanic glass were found, chipped off in the making of arrow-heads. As to the period when these caves were inhabited there is much uncertainty. Sr. Hauthal holds that their occupation must have lasted for centuries, judging by the depth of the accumulations. The caves were formed in the interval between the first great glacial period and the second glacial period in Patagonia.

Sr. Roth has measured the fragments of bone, teeth, etc., of this animal, comparing them with *Grypotherium Darwinii* and other allied species. He infers that *G. domesticum* had the height of a rhinoceros, and was bulkier. It resembled rather the ant bear than the sloth. Sr. Roth has heard from the Indians reports of a huge and formidable animal in the neighbourhood of Lago Buenos Aires, but such tales are quite untrustworthy.

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GENERAL.

The Geographical Association.—We have received the annual report of this society, which now includes one hundred and five members, and is represented in sixty-two schools and colleges. Founded for the purpose of private co-operation in the production of lantern slides, both of maps and views, for the teaching of geography in school, it soon extended its objects to the "promotion of geographical teaching generally." The Association, which is open to all teachers of this subject, has already done good work; its large collections of slides are lent to members, and it continues to press for educational reforms by means of its publications. The list of members includes most of the leading teachers of geography in the United Kingdom. The *Journal of School Geography*, edited, in Britain, by Dr. Herbertson, may be taken to indicate the general aims of the Association.

Dr. Otto Nordenskjold's Antarctic Expedition will start in July 1901, at the same time as the German and English expeditions, and will explore the regions south of South America, establishing a winter station on the South Shetland Islands.

Industrial and Agricultural Population of Germany.—Herr Langhans has mapped the distribution of occupations in Germany, in a recent number of *Petermann's Mitteilungen*. Various shades of green show the degrees of a majority of the population engaged in agriculture, while the industrial regions are indicated by red in a similar manner. The largest industrial districts are those of Southern Saxony, Westphalia, and the Rhine; in the east the only industrial country area is the part of Upper Silesia, which is mostly occupied in mining. In the flat lands of Bavaria industry is almost entirely confined to the towns.

The North Atlantic Ocean.—Dr. O. Pettersson describes the hydrographic researches in the North Atlantic ocean of 1895-96 in the first two numbers of *Petermann's Mitteilungen* for the present year. The paper is divided into three sections, of which the first treats of the report of the Danish *Ingolf* Expedition, which is now being published in six volumes, both in the Danish and English languages, by the Danish Government; the second deals with the British Research Expedition and with Dr. Wemyss Fulton's account of the currents of the North Sea and their relation to fisheries; and the third part deals with the observations made by Scandinavian, Russian, and British students with regard to the most northern part of the Norwegian sea and Barentz sea. The *Ingolf* carried out observations in the seas round Iceland and Greenland, chiefly zoological, but also hydrographical. The part of the report already published consists of the Commander's (Commodore C. F. Wandel) narrative, and Dr. Martin Knudsen's report on the physical and chemical researches of the expedition. Since Frobisher's third voyage in 1578 there has been a tradition of the former existence of an island in the North Atlantic south-west of Iceland, at about 58° N. and 30° W., called Busse island; soundings by the *Bulldog* and *Valorous* have shown a bank in this region; and there have been reports of volcanic activity and earthquakes at the same place. The *Ingolf* found a ridge, which appears to be of recent volcanic origin, forming a prolongation of Cape Reykjanes; the fact that its origin is later than the ice-age is shown by the fact that the bed of the sea was found here to be smooth and even, whereas on both sides of this submarine ridge it is covered with boulders. Temperatures were taken by means of the reversing thermometer as modified by Dr. Knudsen; the salinities were estimated by

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chlorine determinations; and the dissolved gases were measured on board the ship, as it was found in the earlier stages of the work that samples transmitted home suffered changes before estimation. Calculations with regard to the effect of organisms on oxygen and carbonic acid in sea water were published in the *Comptes Rendus* of 1896. A study was made of the relation of the East Greenland polar current to the Irminger stream, which flows northward to the west of Iceland. The latter splits into two at a point south of the Denmark strait, one arm turning south-westward and accompanying the polar stream along its outer margin round the south-east of Greenland, and the other passing northward through the strait and at last becoming an undercurrent to the north-west of Iceland. The East Iceland polar current, which is primarily due to the melting of the ice between Greenland and Jan Mayen, by the warm water moving northward from the Atlantic, is shown to be of very considerable volume, and probably has a profound effect on the circulation off the coast of Norway and in the North sea. Dr. Knudsen thinks that the Irminger stream causes most of this melting. The Gulf stream and the Polar stream meet on the bank between the Färoe islands and Iceland. At the same time as the *Ingolf* Expedition, Captain Moore and the officers of H.M.S. *Research* made observations on the Färoe channel, since published by the Hydrographic Department at the Admiralty. This expedition was sent to carry on the international hydrographic researches begun in 1893, and to complete the earlier observations of the *Jackal* and the *Knight Errant*. Among the more important results were, the determination that the chief flow from the Atlantic into the Norwegian sea takes place over the Wyville-Thomson bank along the north-west slope of the Färoe-Shetland channel; a second branch of the warm Atlantic stream follows the south-east side of the channel and thence spreads over the North sea plateau, at the edge of which it is mixed with the lower and less saline layers. The presence of these two branches of the Gulf stream was demonstrated by the examination of the plankton by Cleve, who also followed out their farther course by floating bottles.

The Production of Tin.—Tin is a rare metal distributed in small quantities in regions of the world far removed from one another. The oldest known mines are those of Cornwall, which in the Bronze Age furnished the supply of Europe, and till forty years ago controlled the market. Now the metal is extracted in the Malay Peninsula, Australia, Bolivia, China, and Japan. The output, according to the *Mining Journal*, rose from 55,100 tons in 1890 to 77,330 tons in 1898. The Malay Peninsula now furnishes the most considerable part, forming 60·6 per cent. of the whole; the Dutch East Indies 19 per cent.; Australia 7·9 per cent; Cornwall 6·1 per cent., and Bolivia 6 per cent. The production of the Dolcoath mine in Cornwall has risen to an average of 2200 tons annually, but the total output of the county has sunk from 12,000 to 6000 tons, owing not to a falling off in the richness of the veins, but to a reduction in the price. The present rise in price affords a favourable opportunity to equip the mines with the latest and most perfect machinery.

The tin zone in Asia extends from Burma and Siam to Sumatra over a distance of more than 1100 miles, the greater part being still untouched. At present the exploitation is confined to the alluvium, and the methods of working are very primitive. The production in the Straits Settlements fell from 49,215 tons in 1896 to 38,942 in 1898, and that of Burma from 67 tons in 1894 to only 15 in 1895. These figures are unsatisfactory, but they do not indicate an exhaustion of the ore, for many deposits have not yet been worked. The Dutch possessions of Banka, Billiton, and Singkep produced 14,265 tons in 1898, also a reduction on previous

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years. China produces one or two thousand tons, and has to import more of the metal to satisfy the demand. Japan yields only a very small quantity. In Australia the chief deposits are in Tasmania, where the output fell from 4507 tons in 1897 to 3229 in 1898; the former, however, was the largest quantity in the past ten years. Smaller quantities are extracted in New South Wales, Victoria, Queensland, and South and West Australia, the total being 9598 tons in 1890 and 6586 in 1897. Mexico alone of the countries of North America contains tin, and a small quantity is extracted. In South America Bolivia alone contains deposits of importance; it exported to Europe 5505 tons in 1897 and 4465 in 1898.

The consumption of the whole world was 83,000 tons in 1898, and 75,500 in 1897, the chief recipients being the United States, Great Britain, Germany, and France. In 1898 the United States took 25,000 tons, Great Britain 13,000, Germany 14,000, and France 8500. The tin-plate manufactured in the year is estimated at 750,000 tons, for which 20,000 to 25,000 tons of tin are required. In America this manufacture showed a considerable development from 1897 to 1898.

Malaria.—Dr. Patrick Manson, medical adviser to the Colonial Office, read a paper on "A School of Tropical Medicine" last month before the Colonial Institute. After describing the method by which malaria is communicated and becomes endemic, he pointed out that it can be stamped out in any district by general drugging with quinine, and also by causing all malarials to sleep under mosquito nets. The Colonial Office, in conjunction with the London School of Tropical Medicine, is supporting the experiments by which Dr. Manson wishes to prove the dependence of malarial infection on mosquitos, in such a clear and striking way as induce the public in tropical countries to take the simple measures which are necessary to clear away the disease. Dr. Manson concluded by an urgent appeal for the study of tropical medicine, as a matter of national importance.

New Zealand.—The *Report of the Department of Lands and Survey* for 1898-99 contains a chapter on the country west of Lake Te Anau, visited in December 1898 by Mr. W. Y. H. Hall. The lake lies to the north-west of Lake Manapouri in the extreme south of Middle Island. The south fiord, an arm of the lake which stretches out westwards, ends in a basin about two miles long, into which the Delta burn enters at the south, and the Esk burn at the north. Between these the Gorge burn enters from the west, its valley separated from that of the Delta burn by mountains 5000 to 6000 feet high, and from that of the Esk burn by a lower range rising up to about 3500 feet. Mr. Hall followed the Gorge burn, which flows through three small lakes and drains several others, and from a peak 4100 feet high obtained a view over the basin of the Esk burn, which also contains several lakes, the uppermost of which was named Lake Duncan. Mr. Hall's companion, Te Au, ascended Forden Peak, which, except a black pinnacle of black rock at the very top, was a sheet of snow for the upper 1000 feet. He reported that he had recognised Bradshaw Sound on the west coast, where he had gone sealing. An attempt was made to descend into the Esk burn, but the ropes were too short for the precipices, and in descending the Gorge burn many awkward precipices were encountered. Mr. Hall then rowed up to the north fiord of Lake Te Anau and found ground game in abundance, whereas at the head of the south fiord scarcely any was to be seen—the ferrets, following the rabbits, having no doubt exterminated it.

Notes are also published on the Sanctuaries for Wild Animals which have been established on several islands, and on a specimen of *Notornis Mantelli* caught in 1898.

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NEW BOOKS.

Baedeker's Central Italy and Rome. With 11 Maps, 46 Plans, a Panorama of Rome, etc. Thirteenth Revised Edition. London: Dulan and Co., 1900. Pp. 454. *M.* 7.50.

Baedeker's Southern Italy, Sicily, etc. With 28 Maps and 19 Plans. Thirteenth Revised Edition. London: Dulan and Co., 1900. Pp. 431. *M.* 6.

These volumes of the indispensable Baedeker for Central and Southern Italy are now in their thirteenth English edition. That the new editions are in steady demand is no doubt due to the fact that the text is thoroughly revised to date, and new and improved maps are always being added.

The Races of Man: An Outline of Anthropology and Ethnography. By J. DENIKER, Sc.D. (Paris). With 176 Illustrations and 2 Maps. London: Walter Scott, Ltd., 1900. Pp. 576. Three Appendices and Index. *Price* 6*s.*

Mr. Havelock Ellis has been fortunate in being able to include this excellent book in the "Contemporary Science Series," for a better outline of anthropology and ethnography does not exist. Dr. Deniker's object is to give in a condensed form the essential facts of the twin sciences of anthropology and ethnography briefly, yet comprehensibly.

The book is designed for all who may wish to obtain, in moderate compass, a general view of these subjects, to understand the foundations upon which the sciences are based, and to be enabled to gain a grasp of an otherwise difficult subject. All can understand this book, for the technical terms are fully explained, and those who wish to go more deeply into the matter are aided to do so by the numerous bibliographical notes which the author has added, and in which he has sought to group, according to a well-thought-out plan, the most important or accessible works. He believes that even professional anthropologists will be able to consult his work profitably, and in this we quite agree. The illustrations are most admirable, and the "types" of the different peoples are from photographs of well authenticated subjects, often such as have been observed and measured by competent authorities or by the author himself.

The arrangement of the book is as follows. After an introduction dealing with ethnic groups and zoological species, somatic, morphological, physiological, ethnic, linguistic, and sociological characters are set forth, and then the author gives us a chapter upon the classification of races and peoples, dealing lastly with the races and peoples of Europe, Asia, Africa, Oceania, and America. In all these chapters strict attention is paid to grouping and to correspondence, and the student is aided in his study by the clear classification of all facts of importance, whilst unimportant matters are relegated to a subsidiary place.

We can warmly congratulate Dr. Deniker on his successful accomplishment of an exceedingly difficult task, and strongly recommend this interesting volume to the attention of our readers.

The Story of West Africa. By MARY H. KINGSLEY. ("The Story of the Empire Series.") London: Horace Marshall and Son, N.D. *Price* 1*s.* 6*d.* Pp. 165 and Index.

The Story of West Africa is of extreme interest, and from Miss Kingsley's previous work one was led to expect that it would be well told, nor are we disappointed, for she has managed, with great ability, to give the history of the West

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African possessions of Great Britain in an admirable manner, and to compress, without obscuring, a great amount of detail.

Commencing with the rise of English influence in West Africa, our author gives an account of all that has happened until the present day, and she is of opinion that the future of West Africa ought to be a prosperous one. She recognises fully that "King Death" has been ignored far too much, but opines that "not with mere human, drifting, striving, narrow effort, nor by emotionalism, however pure, can we succeed in West Africa, but with 'the inward aid of God,' as Spinoza calls Science, we can." She thinks that white men's lives can be saved in West Africa by calling in Science in the domain of Medicine, and also that black men's lives may be saved there, and the true development of the natives into worthy citizens of the world aided, by calling in Science in the domain of Anthropology. By so doing, "we shall not only cease to kill unnecessarily, but shall do a far more important thing—cease to spoil, as we now do, a very fine race of human beings, at considerable expense and to no man's profit. . . . We shall, in fact, succeed in West Africa."

Books like this can only do good, and the more politicians and the public study such the better for our nation and for the welfare of the world.

The Races of Europe: A Sociological Study. (Lowell Institute Lectures.) By William Z. Ripley, Ph.D. Accompanied by a Supplementary Bibliography of the Anthropology and Ethnology of Europe. Published by the Public Library of the City of Boston. London: Kegan Paul, 1900. Pp. 608 and Index, and 160. 222 Portrait Types, and 87 Maps and Diagrams. *Price* 18*s. net.*

The author says in his preface that this work is the outgrowth of a course of lectures upon "physical geography and anthropology" in the School of Political Science at Columbia University in 1896. It originally comprehended, in a study of aboriginal societies and cultures, an analysis of the relation of primitive man to his physical environment. Gradually, with a growing appreciation of the unsuspected wealth of accumulated data, it has expanded along lines of greater resistance, concentrating attention, that is to say, upon Europe—the continent of all others wherein social phenomena have attained their highest and most complex development. It represents an honest effort to co-ordinate, illustrate, and interpret the vast mass of original material—product of years of patient investigation by observers in all parts of Europe—concerning a primary phase of human association: that of race or physical relationship. The abundant store at the author's disposal has not only been brought into orderly arrangement, but has been rendered accessible to future investigators by the supplementary bibliography. The graphical representation of facts by maps, which should conform to strictly scientific canons, has been well accomplished by the author himself, or rather, the author with the aid of his wife, whose constant material aid, as well as inspiration, he fully recognises. These maps aid inestimably the elucidation of the difficult yet interesting subjects dealt with in the volume. The portrait types, too, are exceedingly valuable; they have been selected with very great care by those having an intimate knowledge of the people of each country.

The six years' work required by the author and his wife for the completion of this undertaking is amply repaid, for we have rarely had the pleasure of reviewing a more intricate and successful volume.

Professor Ripley's interpretation of the complex material with which he had to deal is highly successful, perspicuous, and convincing; his touch is broad, but

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at the same time painstaking, and we obtain from a perusal of his chapters a definite impression as to the why and wherefore of the sociological problems or physical peculiarities exemplified in the various European nations. He shows, for instance, that language and customs or culture are independently migratory, that languages are often political or official, whereas customs seldom are so. Languages seldom coalesce, whereas, on the other hand, borrowing in custom or culture is very common. To take another point, he shows, in Chapter III., how the form of the head is no criterion of intelligence, and that the size of the head is unimportant, but that there are geographical parallels between head forms, fauna, and flora, and that the head form is not affected by environment; and he brings out a curious fact, that artificial selection operates but little in respect of head forms, whereas it is exceedingly common in facial features. Artificial selection "is peculiarly liable to play havoc with facial features, for which reason these latter are rendered quite unreliable for purposes of racial identification. Because they are entirely superficial, they are first noted by the traveller, and used as a basis of classification. A case in point is offered by the eastern Eskimos, who possess, in marked degree, not only the almond eye so characteristic of the Mongolian peoples, but also the broad face, big cheek-bones, and other features common in other people of Asia, yet, notwithstanding the superficial resemblance, inspection of our world map of the head form shows that they stand furthest removed from the Asiatic type. They are even longer-headed than most of the African Negroes. The same phenomenon confronts us in our analysis of the aborigines of Russia. . . . Happily for us, racial differences in head form are too slight to suggest any such social selection as has been suggested: moreover, they are generally concealed by the head-dress, which assumes prominence in proportion as we return towards barbarism. Obviously a Psyche knot or savage peruke suffices to conceal all slight natural differences of this kind, so that Nature is left free to follow her own bent without interference from man. The colour of skin peculiar to a people may be heightened readily by the use of a little pigment; such practices are not infrequent; to modify the shape of the cranium itself, even supposing any peculiarity were detected, is quite a different matter. It is far easier to rest content with the modification of the head-dress, which may be rendered socially distinctive by the application of infinite pains and expense."

"However strenuously the biologist may deny validity to the element of artificial selection among the lower animals, it certainly plays a large part in influencing sexual choice among primitive men, and more subtly among us in civilisation. Just as soon as a social group recognises the possession of certain traits to itself, that is, as soon as it evolves what Giddings has aptly termed a 'consciousness of kind,' its constant endeavour thenceforth is to afford the fullest expression to that ideal. Thus, according to Balz, the nobility in Japan are as much lighter in weight and more slender in build than their lower classes, as the Teutonic nobility of Great Britain is above the British average. The Japanese aristocracy, in consequence, might soon come to consider its bodily peculiarities as a sign of high birth; that it would, thereafter, love, choose, and marry—unconsciously, perhaps, but no less effectively—in conformity with that idea, is beyond peradventure. Is there any doubt that where, as in our Southern States, two races are socially divided from one another, the superior would do all in his power to eliminate any traces of physical similarity to the menial Negroes? Might not the Roman nose, light hair and eyes, and all those prominent traits, which distinguished the master from the slave, play an important part in constituting an ideal of beauty which would become highly effective in the course of time? So uncultured a people as the natives of Australia are pleased to term the Europeans in derision 'Tomahawk-

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noses,' regarding our primary facial trait as absurd in its make-up. Even among them the 'consciousness of kind' cannot be denied as an important factor to be dealt with in the theory of the formation of races."

One is tempted to make many quotations from this volume, but we must refrain. Our author deals with blondes and brunettes, stature, the three European races, indeed describes the characteristics of all the inhabitants of Europe, and deals at length with their culture and social problems, as well as those modern social questions comprised under stratification and urban selection. The final chapter deals with acclimatisation, and the geographical future of the human races with conspicuous ability.

The book is one which is difficult to lay down, and will amply repay careful study.

Natal, the Land and its Story. A Geography and History, with Maps. By ROBERT RUSSELL, Superintendent of Education, Natal. London: J. M. Dent and Co., 1899. Pp. 280 + Index ix. *Price 2s. 6d. net.*

This is a manual of the geography and history of Natal, suitable for higher schools in the colony, and for all persons, anywhere, who may require a compendious geographical and historical account of it. The history begins at Vasco da Gama's christening of the coast on Christmas day, 1497, and extends to 1897. The author's style is simple and concise, and the matter—a store of indispensable and apposite facts—is well arranged and printed for both mind and eye. The events immediately preceding the recent invasion of Natal by the Boers of the Transvaal and Orange Free State are not reached in the book. But the historical narrative necessarily contains much information about the Boers, and the part they have played in South Africa generally, and in connection with Natal in particular. The same remark is applicable to the account given of the Kafirs (Bantu races), and the incidents of their contact with the white man. As a whole the information conveyed in the book is, as far as we can judge, both accurate in fact and uncoloured by racial or political prepossession—the latter a characteristic of not less importance than the former in a school book, of all books.

Journals and Papers of Chauncy Maples, D.D., F.R.G.S., late Bishop of Likoma, Lake Nyasa, Africa. Edited by ELLEN MAPLES. Longmans, Green, and Co., 1899.

How worthy to be named with Livingstone and Mackenzie, Mackay and Bain Bishop Chauncy Maples is, we showed in a review of his *Life* in these pages. This collection of his published writings on Central Africa completes the service done by his sister to the civilisation and Christianisation of the Bantu peoples. So long ago as 1888 our *Magazine* published his model paper on "Likoma," the little island in Lake Nyasa, from which the missionary bishopric is named. That article is here reproduced with several others of almost equal merit, on the countries in Portuguese and German East Africa, in which he made his missionary tours, such as Meto, Newala, and the land of the fierce Gwangwara. Better even than these are the zoological and other natural history descriptions, which have been revised by experts. Better still are the manly, broad-minded, and deeply spiritual discussions of missionary methods and native conversions, in which the merits of such Scots missionaries as Dr. Laws and his colleagues, both of Livingstonia and Blantyre, are heartily acknowledged. The paper on "Witchcraft" is a fine statement of the possibly supernatural side of the abomination, but it should be supplemented by the more scientific and experienced writing of the late Andrew Smith of Lovedale. A good map and portrait complete this valuable book.

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Twelve Pioneer Missionaries. By GEORGE SMITH, C.I.E., LL.D. With Portraits. Pp. 304. London, Edinburgh, and New York: Thomas Nelson and Sons, 1900. *Price 7s. 6d.*

The occasion for the issue of this volume is the recent celebration, by more than one of the great British Protestant Missionary Societies, of the completion of the first century of their existence. The list of twelve missionaries selected for commemoration by Dr. Smith comprises by no means all the pioneers of Christian missionary enterprise in modern times in the various non-Christian countries of the world. Some notable names are absent; and several non-Christian regions where the propagation of the Christian religion is being carried on are unmentioned, or barely referred to. Seven of the selected pioneers laboured in India (two, indeed, being natives of India), three (one of them in the thirteenth century) in Africa, one in Arabia, and one in the islands of the South Pacific. But the author, doubtless, had reason for his choice of men and mission-fields; and in most instances he has conjoined with the biography some account not only of the circumstances that led to or attended the pioneers' going-forth, but also of subsequent missionary efforts in the same region.

Little notice is taken in the book of missionary journeys of exploration. From this fact, and from the somewhat fervid and discursive tone of the book, it would seem to be chiefly intended to enhance the missionary sentiment and to encourage the faith of religiously minded people. In this respect the book scarcely falls within the purview of a geographical reviewer. There is, however, one aspect of its subject with which geography, as a secular science, and as connected with social and political history, is concerned. Few will doubt that if the Christian religion were largely to supplant, in non-Christian countries, the existing religious systems and customs, and were to become part and parcel of the national life of the populations, their mental and moral character and social development would be greatly changed. From this, political and social results might—we may perhaps say, would certainly—ensue, which geography, in the wide sense of the term, would have to take cognisance of. It is still a day of small things with modern Christian missions. In India, for example, not one-half per cent. of the native population is Christian, and in almost every part of the country one may go a day's journey without encountering, or hearing of, a native Christian. Yet the parables of the mustard seed and the leaven are still read and heard among us. If they foreshadow the event, the future historians and geographers of our present non-Christian countries will have strange things to record in centuries to come. To them the missionary story of the nineteenth century will be of surpassing interest. It ought not to be devoid of interest now, even if the interest be only speculative.

Bougie, die Perle Nord-Afrikas. Prag: Heinr. Mercy Sohn, 1899. Folio. Pp 122.

The illustrious (although anonymous) author of this magnificent account of Bougie, an Algerian seaport some 130 miles eastwards of Algiers, considers that, from its salubrity, fertility, and picturesque beauty, Bougie is the "Pearl of Northern Africa." "Its atmosphere is, owing to the proximity of what has been called the African Switzerland, elastic and fresh, and healthier than anywhere else in Algeria, or, indeed, in Northern Africa. The district is one of the loveliest on the Mediterranean coast." Numerous illustrations after the author's own sketches complete this remarkable work, which is both creditable to the printers and engravers of Prague, as well as worthy of its author, who has written so many similarly splendid monographs reviewed in this *Magazine*.

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THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

THE GLACIAL PALAGONITE-FORMATION OF ICELAND.

By HELGI PJETURSSON, Cand. Mag., Copenhagen.

I. INTRODUCTION.

IN this paper some account is given of certain recent observations on the Tuff and Breccia or so-called Palagonite-formation of Iceland. By geologists generally this formation is believed to be of volcanic origin—to consist, in short, of fragmental ejecta principally. Interstratified with the breccia, however, there occur now and again beds of conglomerate, which are supposed to be old river-gravels. My observations lead me to very different conclusions. The breccias, in my opinion, are to some extent of glacial origin—many of them, in short, are indurated ground-moraines or "boulder-clays." Further, I believe that these "palagonite moraines" (as they may be provisionally termed) are the products of several successive glaciations, all of which preceded that final glaciation of the island which is the only one hitherto recognised by geologists.

The term "palagonite-breccia" has been so long current that it would perhaps be inconvenient to drop it, and I have therefore continued to employ it. I am well aware that Dr. Penck has shown that palagonite[1] is not a mineral, and it is further true that the "palagonite-moraines" are, strictly speaking, not breccias. I continue to use these terms, however, partly to emphasise the fact that the rocks in question have not now been observed for the first time, and partly to avoid confusion, as conglomerates made up of well-rounded stones are found to be interbedded with the morainic rocks.

The observations in question were made chiefly on mountains or

[1] A. Penck, "Ueber Palagonit- und Basalt-tuffe."—*Zeitschr. d. deutsch. Geol. Ges.*, 1879, p. 568.

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hills rising out of or bordering the southern lowlands of Iceland. But before proceeding to describe them I may make some brief remarks on the geography and geology of the island, and more especially of the district I have just referred to.

We have at present a fairly good general knowledge of the physical features of Iceland, which is due largely to the untiring energy of the well-known Icelandic geographer and geologist, Dr. Th. Thoroddsen, to whose works I shall have frequent occasion to refer.

"Iceland, which has an area of 40,450 square miles, may be broadly described as a plateau land, built up of volcanic rocks of both older and newer formation"; the lowlands "embrace only about one-fourteenth of the entire area."[1] The largest of these lowlands lies in the south of Iceland "between the peninsula of Reykjanes and Eyjafjallajökull," and comprises "a tract some 1550 square miles in extent."[2] Of the rivers flowing across the southern lowland I may mention Hvítá and Thjórsá; the latter, 125 miles in length, is the longest river in the island.[3] The tributaries of the Hvítá are Tungufljót (on the right) and Stóra Laxá (on the left); Minni Laxá is tributary to the latter. The Thjórsá receives several tributaries, but I need mention only the Sandá and the Fossá, which skirt the west and the east sides respectively of the district named Thjórsárdalur. The region extending between the middle reaches of the Hvítá and the Thjórsá comprises the three districts known respectively as Hreppar, Ytrihreppur, to the west of Stóra Laxá, and Eystrihreppur to the east of it.

A few words now as to the geological constitution of Iceland. According to Dr. Thoroddsen the island is built up principally of basalts and palagonitic breccias, the former representing ancient lava-flows, while the latter are believed to be the consolidated fragmental materials of volcanic eruptions. These breccias, "which are of younger formation than the basalt, stretch in an irregular belt diagonally across the island."[4]

The lowland now occupies the south-western end of this very irregular belt, and is an "area of subsidence bounded by faults reaching down to the foundations of the mountains."[5]

The leading structural lines of the region, as exhibited by the trend of mountain-ridges, by chains of volcanic cones, by hot springs, and sometimes also by the river courses, have a SW. to NE. direction. The SW. to NE. faults or dislocations are crossed by transverse faults, and it is along these lines that portions of the breccia-plateau have subsided to form the lowland.

Looking west from the mountain-wall that towers above Stóra Laxá this structural feature is very apparent. The eye wanders over the broad county of Ytrihreppur, which is traversed from south-west to north-east by a series of brown escarpments of breccia-rock that alternate with green strips of marshy land. It looks as if some giant plough, moving in that direction, had broken up the rocky crust. But

[1] Thoroddsen, 'Explorations in Iceland during the years 1881-98."—*Geographical Journal* for March and May 1899.

[2] Thoroddsen *loc cit.*, p. 25.

[3] Thoroddsen, *loc. cit.*, p. 30.

[4] Thoroddsen, *loc. cit.*, p. 31.

[5] Thoroddsen, *loc. cit.*, p. 25.

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the plough ridges are much interrupted, the larger portion of the shattered crust having subsided to form the low-lying marsh-lands. But the tilted position assumed by those portions of the ridges which still project, clearly indicates how great has been the havoc wrought upon the plateau, of which they are merely fragments.

Dr. Thoroddsen is of opinion that the southern lowland probably came into existence in late Tertiary times. After its formation it was overflowed here and there by doleritic lavas, which were grooved and polished by the glaciers of the subsequent ice age.[1] Dr. Thoroddsen remarks that he has nowhere found morainic débris or glacial striations underneath those glaciated streams of lava,[2] from which he concludes "that the lava was in all probability ejected anterior to the glacial epoch."[2] Again he states that, "At the time these pre-glacial lava-beds were laid down, the country had pretty much the same essential contours that it has at present."[3]

Now it is quite certain that these so-called "pre-glacial lavas" have been erupted anterior to a glacial epoch. As I shall presently show, however, the lavas in question are not really pre-glacial, but were actually preceded by earlier phases of glaciation. This is proved by the fact that mountains which overlook the lowland and others which rise like islands in its midst are partly built up of indurated bottom-moraines. The rocks of the mountains in question are clearly older than the lowland, and the lowland was certainly in existence before the so-called "pre-glacial lavas" were erupted. There can be no doubt, therefore, that the latter are younger than the glacial breccias which enter into the formation of the relict mountains referred to. This is an obvious conclusion, and its truth is confirmed as we shall see by the evidence of direct superposition.

I would here gratefully acknowledge my indebtedness to the Danish Government and the University of Copenhagen, whose liberality enabled me to make the excursions, the general results of which are here recorded. When I started on my journey I had no intention of making any special examination of the "palagonite-formation." The object I had chiefly in view was the investigation of the "post-glacial marine deposits" and raised beaches of the southern lowland, and my observations on these I hope to publish ere long. But when in Ytrihreppur I chanced to be struck with the resemblance which a breccia-rock, though tilted, presented to a very stony boulder-clay, and on closer examination I found that the breccia contained some stones that were apparently ice-scratched.

The passages I have cited from recent writings by the first authority on Icelandic geology will show that I could not have anticipated finding traces of glacial action on a lower geological horizon than the so-called "pre-glacial lavas." Indeed, I could hardly at first believe the evidence of my own eyes. It was difficult to realise that hard, tilted rocks, traversed by dykes of basalt, could be true bottom-moraines. But on following up my first observation I found it was impossible to escape the

[1] Thoroddsen, *Jardskjálftar á Sudurlandi*. Edited by the Icelandic Literary Society. Kmh., 1899. P. 21.

[2] *Geographical Journal*, 1899, p. 23.

[3] *Loc. cit.* p. 35.

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conclusion, that a very considerable portion of the "palagonite-breccias" of the district was in reality of glacial origin.

The summer of 1899 was phenomenally rainy in the south of Iceland, whereby I was seriously hindered in my work in more than one respect.

II. Description of Localities.

It will be seen by reference to a map of Iceland, that a broad tongue of the high plateau stretches south-westward into the lowland, between the rivers Hvítá and Thjórsá. The south-western border of this mountainous region is rather broken up and irregular. In the south-east, Búrfell rises with steep acclivities to a height of 1450 Danish feet above the adjoining low grounds, while Berghylsfjall on the north-western corner has probably a similar height. A smaller portion of the plateau extends farther towards south-west than the mountains just referred to, and faces with steep walls the dislocated and depressed regions towards the east and west. These steep mountain-sides belong to Hlídarfjall, towards the west, on Stóra Laxá, and to Hagafjall rising over the Thjórsá towards the east.

My first observations on the indurated moraines or morainic breccias were made in the county of Ytrihreppur, to the south-west and south of Berghylsfjall, where the hills, or broken fragments of the breccia-plateau rise out of the marshy flats in such a manner as sometimes to remind one of tilted icebergs in a smooth sea.

One of these hills is Hellisholtsás, a short distance to the north of Midfellsfjall. This eminence presents a bold escarpment towards the east and a more gently inclined slope towards the west. The upper portion of the hill is composed of breccia, consisting of a grey, hard, sandy matrix crowded with a great number of mostly subangular blocks of basalt measuring up to 3 to 4 feet across. Many of the stones are distinctly striated and cannot in that respect be distinguished from striated stones in loose glacial accumulations, such as those which are seen on Midfellsfjall. The matrix is very hard and well jointed, the steep escarpment being determined by the jointing. When viewed from a distance the breccia seems in places to be made up of curved layers dipping steeply towards the south. Thin lenticular layers of fine-grained, distinctly stratified material are intercalated in the breccia, more particularly in its lower portions. I noted one sandy layer having a thickness of 4 to 5 inches and a length of nearly 2 feet. The matrix also seemed to be finer grained around some of the enclosed blocks. The breccia reaches a thickness of about 30 feet. It rests on basalt and is cut by a basaltic dyke about 3 feet thick. The underlying basalt seemed not to be intrusive here, and in a lower ridge to the west of Hellisholtsás, where the same sort of breccia rests on basalt, the latter had been broken up and blocks of it were enclosed in the breccia. The surface of the breccia itself appears to be moutonnée, but no striæ were observed.

This breccia I take to be a true ground-moraine—the product of an ice-sheet older than that which covered the country when the latter "had pretty much the same essential contours that it has at present."

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My description of the grey breccia of Hellisholtsás applies to nearly all the grey breccias to be mentioned presently, their essential characteristics being: (1) the commingling of material of every size of grain, from fine clay up to big-sized blocks. The blocks are partly angular and partly blunted, the latter generally being most numerous, and some are striated. Sometimes, as in the breccia of Hellisholtsás, a rude bedding can be observed, when the section is viewed from a distance, but, as Professor Geikie remarks of certain Scottish boulder-clays, "on a nearer approach this appearance of stratification often vanishes—we cannot see the structure for the stones";[1] (2) the intercalation in the breccias of minor quantities of stratified, fine-grained material, the bedding often being diagonal. Further, as will be mentioned later on, some of the breccias were observed to rest upon a distinctly striated and grooved rock surface. This fact, taken in connection with the morainic character of the breccias themselves, seems to me to demonstrate the glacial origin of those breccias.

Nearly every hill I examined in Ytrihreppur was to a less or greater extent built up of these morainic breccias; but it would extend this paper to undue limits were I to record more than a few of my observations. My purpose at present is simply to call attention to the existence of these interesting glacial deposits rather than to give detailed descriptions. I will therefore make reference to only a few localities in Ytrihreppur in addition to that already described.

Midfellsfjall rises to a height of probably 1000 feet or thereabout above the surrounding marshes. It is an insulated and tilted fragment of the old breccia-plateau, the layers dipping north-westward. On the top of the mountain there is a lake extending from south-west to north-east.

In a ridge on the west side of the mountain, not far from the top, the following succession of rocks was observed:—

5. Loose glacial accumulations
4. Brown breccia (palagonitic) } about 40 ft.
3. Slaggy basalt
2. Grey breccia (indurated ground-moraine), 50 ft.
1. Basalt.

The basalt (1) underlying the breccia (2) was in one place seen to be distinctly striated in a direction about N. to S. The portion of the basalt on which these ice-markings occur seemed to be separated by rents from the main mass of the rock, but has remained in place, or very nearly so.

The grey breccia (2) closely resembles the breccia of Hellisholtsás already referred to, and contains a great number of distinctly striated stones, which hardly ever exceed a man's head in size. Towards the base of the accumulation occur in some places many angular blocks of basalt derived from the broken-up surface of the underlying rock. Near the line of contact of the breccia with the overlying slaggy basalt (3) blunted stones can be observed in a brownish-yellow matrix.

The breccia (4) contains slightly subangular stones in a brownish-yellow matrix, with many fragments of a basaltic glass, which also coats

[1] J. Geikie, *The Great Ice Age*, 3rd edition, p. 13.

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some of the enclosed stones. It is in character very different from the grey breccia (2) and appears to be of volcanic origin.

The loose glacial accumulations (5), with blunted and indistinctly striated stones, occur in small quantities in hollows of the ridge. The ridge next to the east of this forms the highest part of the mountain, and overlooks the lake. Here the same section of rocks could be observed as above, with exception of the basalt (1). The grey breccia (2) was better jointed here than in the western ridge, and the enclosed stones were cut by the joints. A basalt dyke cutting the breccia seemed to have about the same direction as the lake (NW. to SE.)

Farther north in the same ridge a grey breccia, probably the continuation of that just mentioned, was observed resting on and succeeded by basalt. Every stone I cut out of it showed distinct glacial striæ. It has the usual grey tint, but towards its line of contact with the upper basalt it becomes reddish in places. The breccia is of very variable thickness, dwindling in one place to some 5 or 6 feet.

The mountain descends to the marshes on the east with a steep declivity, broken by irregular steps towards the base. A brown morainic-looking breccia with blunted stones—none of which, so far as I saw, showed striæ—was observed at a height of about 60 feet above the marshes. Higher up there is a partly grey and partly brown breccia, in which I found one boulder showing very clearly marked glacial striation. The thickness of this sheet is about 20 feet. Farther north one step-like bench in the mountain-slope consists of hard, grey breccia with many striated stones; it rests on basalt, and its greatest thickness is 80 to 90 feet. Whether this layer is a continuation of the 20 feet sheet I cannot say; it presents a very great likeness to the 100 feet layer in Búrfell to be mentioned later on.

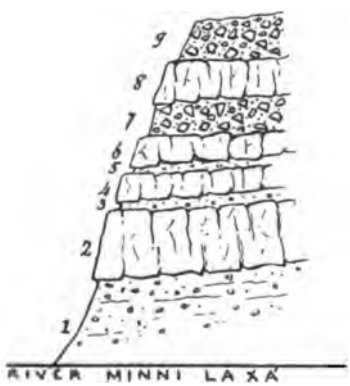

FIG. 1.

1. Conglomerate, 40 to 50 ft. visible: 2. Basalt (thick): 3. Volcanic Breccia: 4. Basalt (thick): 5. Volcanic Breccia: 6. Basalt: 7. Morainic Breccia: 8. Basalt, 80 ft.: 9. Morainic Breccia, about 70 ft.

It would thus seem that there are several separate and distinct sheets of indurated ground moraine entering into the composition of this mountain. It is possible, nevertheless, that there may be but one—the same sheet having perhaps been brought down to different levels by faults. Unfortunately bad weather prevented me spending as much time upon this somewhat difficult investigation as I should have liked.

My next excursion was to Berghylsfjall, 4 to 5 miles to the north-east of Midfellsfjall. I ascended the mountain from the east. Here, in a steep cliff, the base of which is washed by the river Minni Laxá, the following section is exposed (Fig. 1):—

The bottom of the conglomerate (1) was not seen, but its surface rises towards the north until the bed reaches a visible thickness

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of 40 to 50 feet. The constituent stones are well rounded and of a rather equal and moderate size, none being observed to reach that of a man's head, and the aspect of the rock is very different from that of the morainic breccias. The conglomerate graduates downwards into what would be more properly called a sandstone; it has a greenish hue and contains many boulders of a soft greyish-green rock, probably a very decayed basalt. The colour of the conglomerate is changed to reddish-grey down to a depth of about 4 feet beneath the overlying basalt (2). The breccia (3) is composed of red scoriæ or cinders in a red matrix. The basalt (4) overlying it is very like the basalt (2). [It may be that the breccia (5), which is very similar to (3), does not rest directly upon the basalt (4), and that some rock intervenes between the two, for I have only noted that (5) is on a higher level than (7).]

The breccia (7) is of a brown or greyish-brown colour, and contains big subangular stones and a greater number of smaller boulders, which, although for the most part scattered irregularly through the whole mass, yet sometimes show a linear arrangement, indicating a kind of bedding. Some of the stones were striated, and I suppose it is safe to conclude that the whole deposit is an indurated ground-moraine.

The breccia (9) overlying the thickest sheet of basalt (8) is in its lower portions greyish and charged with blunted stones, while here and there appear lenticular layers of stratified fine-grained materials. Passing upwards, the matrix becomes greyish-yellow, and contains slaggy fragments of basalt—the whole resembling very much a volcanic breccia, throughout which, however, some blunted stones are scattered. This yellow breccia graduates in a horizontal direction into a grey rock of the usual morainic character. In this I found one boulder showing glacial striæ. On the west side of a hollow of erosion the continuation of this grey morainic rock is exposed in a section showing a thickness of about 60 feet. Striated stones were rare.

To the west of this ridge is a deeper hollow, on the other side of which the chief bulk of the mountain lies. Glancing up the mountain slope, it appears to be built up of basalt to a greater extent than of breccia. A bed of the latter rock, which from a distance seemed to have a morainic aspect, was thought likely to be the continuation of the 60 to 70 feet breccias described above. At a considerably greater height I observed a breccia, with blunted stones, resting on basalt. The rock was 20 feet thick, and had a morainic appearance, but striated stones were not detected. This breccia is apparently represented a little higher up and farther north by a similar rock which has a thickness of 40 feet. It is traversed from north to south by a dyke of basalt 2 feet thick. The breccia is reddened for a distance of 6 to 8 inches from the walls of the dyke. A little distance farther north and higher up I observed a considerable mass of breccia having essentially the same structure and appearance as that just referred to, but its constituent boulders were not so big, and a few of them showed glacial striæ. Here, also, a basalt dyke (8 feet or so thick) cuts the rock from north to south, and reddens the breccia for a distance of 2 feet on either side.

Here the breccia was overlaid by a sheet of polished and striated

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basalt. The direction of the striæ on the surface of the basalt was NE. to SW., but on a corner of rock the direction was observed to be about E. to W. I was not able to make out with certainty whether this special case is one of intersecting striæ of different age, or whether the divergence was simply due to deflection. But at several other places, to be subsequently referred to, I observed intersecting striæ having the same directions, and the E. to W. system could be clearly shown to be the younger.

Arrived at the highest ridge, which is sprinkled with erratics and perched blocks of basalt, I observed a very peculiar-looking greyish breccia. It had a kind of slaty structure, as it were, and could be more or less readily split up. The rock is decidedly morainic, containing as it does a number of polished and striated boulders. It rests on basalt, many angular fragments of which, reaching the size of a man's head, are included in the lowest portions of the breccia. Higher up the stones are subangular, and curved layers of sand appear.

Farther east, on the same ridge, the breccia reaches a thickness of 20 feet or more. The "slatiness" is here not so well marked, or is even absent altogether. The underlying basalt at this place has the same shattered and broken appearance; but at one spot where it projects about a foot beyond the outcrop of the overlying breccia it shows a fine surface of glacial polish and striation. I satisfied myself that there could be no mistake as to the relative position of this glaciated rock-surface—it clearly passes in below the breccia. Moreover, its situation is such as to preclude the possibility of its having been produced during the latest glaciation of the district. The rock-surface in question shows two sets of striæ which could hardly have been engraved at one and the same time. It is not, in my opinion, a case of deflection. One set trends from north to south, or a few degrees east of south, while the direction of the other is from N. 35° W. to S. 35° E. The inequalities of the surface exposed are slight, but the N. to S. striæ appear on what are lee-sides with regard to the south-east movement, from which I infer that the N. to S. set is the older of the two.

The breccia is traversed from north to south by two parallel basalt-dykes, which have a thickness of about 2 and 8 feet respectively—the distance between them being 60 to 70 feet. It may be noted that these dykes correspond in thickness and direction to the two which were observed at a lower level on the same mountain-slope.

The presence of those dykes, and of others which I saw but have not specially referred to, shows how greatly the configuration of the region has changed since the latest of the indurated ground-moraines was accumulated. For it is obvious that the mountain-ridges I have been describing could not have existed as such when the liquid igneous material was injected into the fissures, where it cooled and solidified. This of itself is sufficient to prove that the morainic breccias are older than the so-called "pre-glacial dolerites" which occupy the low grounds. The former were in existence before the old plateau became shattered and dislocated; the latter were not erupted until after this process had been completed.

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In trying to ascertain how many separate beds of morainic breccia occur in the locality at present under review, we meet with the same difficulty as was experienced in Midfellsfjall. We cannot be quite sure that the breccias which crop out at different heights occur on just so many different geological horizons. It may be that the same bed is sometimes repeated by faulting. In the present case, however, this source of error is excluded for two of our breccias—namely, for the beds (7) and (9) in the section on Minni Laxá. To the west of a considerable hollow another section showed a breccia which I took to be the continuation of the layer (9). The bed numbered (7), however, did not appear; it had probably dipped out of sight, the inclination of the strata being westerly. Higher up than (9) two apparently separate and distinct sheets of moraine crop out, but I could not be quite certain that these were not outcrops of one and the same breccia repeated by faulting. It seemed to me, however, extremely improbable that bed (9) and the uppermost moraine (which rests on a striated surface of basalt) could be outcrops of one and the same sheet. I therefore incline strongly to the view that in this mountainous fragment of the old plateau there are at least three separate and distinct sheets of morainic breccia. And there may well be more, for I did not examine Berghylsfjall so carefully and minutely as I could have desired. To go over the mountain in such a way as to exhaust the evidence would probably take as many days as I spent hours in my examination; and a similar remark, unfortunately, would hold true for nearly all the localities I visited.

Hlíðarfjall rises steeply to the east of Stóra Laxá, and from its summit one looks over an extensive, nearly flat surface, which has its continuation in that of Galtafellsfjall, the precipitous slopes of which front Laxá on the west. When the flat summits of these mountains are seen from the top of Midfellsfjall, they seem to form a nearly continuous plain, which presents a very marked contrast to the broken, hilly surface of Ytrihreppur. The summit of Hlíðarfjall is composed of basalt, which shows a highly glaciated surface. Close to the edge of the bounding precipice of the mountain, the smoothed basalt shows in one place two sets of grooves and striæ very distinctly. The older set (consisting of grooves) trends SSW., while the younger set (consisting of striæ) trends a few degrees N. of W.

Under the basalt comes grey, morainic breccia, with blunted stones of different sizes, the biggest measuring nearly 2 feet across. Striated stones were rare. Abutting against the south side of a very stony portion of the breccia, a layer of stratified sandstone was observed. In another place a kind of rude curved arrangement appeared, while little lenticular layers of fine-grained material were quite common. These layers seemed to accommodate themselves to the bigger blocks.

The basalt, forming the topmost layer of Galtafellsfjall, was observed in one place overlying a grey rock, which on examination proved to be a conglomerate of well-rounded stones. This bed has a visible thickness of 30 to 40 feet, and is coarsest towards the top. For these details I am indebted to my friend Mr. Páll Lýdsson (of Hlíð, Eystrihreppur), who visited the locality at my request. Bad weather had, unfortunately, pre-

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vented me going to the place. During a part of my journey I was accompanied by my friend, who is an excellent observer, and keenly interested in geology. I shall have occasion in the sequel to mention some observations he made when in late autumn he was travelling over the uninhabited regions to the north of these districts, on the look-out for stray sheep.

The base of the conglomerate referred to is not seen, but it probably rests on ground-moraine, like that observed underlying the basalt of Hlídarfjall.

For one who, like myself, had set out on his investigations in the belief that "the general structure and contour-lines of Iceland were in all respects essentially the same before the glacial epoch that they are to-day," it was certainly strange to realise that the mountains of which our morainic breccias constitute a part, are merely the relics or fragments of an old land-surface which in the districts I have been describing has now largely disappeared. Strange indeed was it to reflect that the existing configuration of the land is of more recent origin than glacial accumulations which are themselves probably not the oldest of their kind in Iceland.

We now proceed eastward to the hills of Stórinúpur, near Thjórsá. These hills rise to a height of probably 400 or 500 feet above the river, and on the south side of it they are continued by Skardsfjall which, according to Dr. Thoroddsen, has a height of 724 feet above the surrounding plain. So far as I was able to make out, the breccia of the hills of Stórinúpur is entirely of glacial origin. The stones of this breccia are mostly blunted; only few, however, appear to be distinctly striated. But one of the finest examples of glaciated stone I ever saw was detected in the freshly fractured face of a huge block of brown breccia which had been rent from the rocky wall above, during the tremendous earthquakes in 1896.

The walls of a ravine in the neighbourhood of the parsonage of Stórinúpur are beautifully grooved and striated. Here the stones of the breccia had undergone a renewal of their glacial experiences, and appeared on the polished rock-wall as patches of a colour different from that of the brown matrix in which they are set. At the bottom of this same ravine occurs a patch of recent ground-moraine of a grey and brownish-grey colour. The stones of this boulder-clay could easily be dug out with a spade, and neither in form nor in the character of their striation could they be distinguished from the glaciated stones of the "palagonite-moraines," which could only be extracted from their matrix by means of hammer and chisel. It is worthy of note that the quantity of the unconsolidated moraine or boulder-clay is quite trifling in comparison to the enormous masses of the "palagonite-moraines."

The most interesting district I visited in the course of my investigations was the mountain-slope to the west of Thjórsá (Hagafjall) and Thjórsárdalur. I was accompanied on the occasion of my visit by Mr. P. Lýdsson, and for a few days we were favoured with good weather. I could examine only a comparatively small portion of this district, and that not in so detailed a manner as I wished, but the deluge of rain that

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succeeded our short interval of fair weather rendered further investigation impossible.

As before indicated, Hagafjall on the Thjórsá represents the eastern border of a comparatively continuous stretch of plateau, as Hlídarfjall represents its western border. Separated from Hagafjall by a hollow are two smaller promontories, rising with precipitous walls from the Thjórsá. These are named Bringa and Gaukshöfdi, the first mentioned being farthest north. Just here we obtain as good evidence as one could desire to show that the "palagonite-moraines" are not the products of one single glaciation.

FIG. 2.—SKETCH—SECTION OF BRINGA.

1. Morainic Breccia, 20 ft.: 2. Conglomerate, 80 ft.: 3. Basalt: 4. Volcanic Breccia, 6 ft.: 5. Basalt: 6. Volcanic Breccia, 12 ft.: 7. Basalt: 8. Morainic Breccia, 14 to 16 ft. The beds dip north.

Thus in Bringa (see fig. 2) the following succession of beds is clearly exposed:—

The breccia (1) is of a decided morainic character. It contains striated stones of moderate size, rarely exceeding that of a man's head, set in a light grey, fine-grained matrix, and rests on a striated surface of basalt. The striation is not very distinct, but seems to have a N. to S. direction. The rocks below this point (which was at a considerable height above the river) were inaccessible.

The conglomerate (2) appears to be made up chiefly of well-rounded stones, the grey matrix, which enters so largely into the composition of the underlying bed (1), being nearly absent here. The conglomerate is arranged in layers that dip at a considerable angle towards south.

Above the superjacent columnar basalt (3) comes a true volcanic breccia (4). It is composed entirely of scoriæ or cinders, imbedded in a greyish-yellow matrix, which probably represents volcanic ash or dust.

The basalt (5) is of inconsiderable thickness, and is notably slaggy in its lower portion.

This basalt is succeeded above by another volcanic breccia (6), in the upper part of which occurs a bed of laminated volcanic sand about 1 foot in thickness. Although obviously forming a portion of the breccia, into which it graduates above and below, the sand apparently points to deposition in or arrangement by water.

The highest bed is a breccia (8) which differs somewhat from the breccia (1). Its matrix is in places of a brownish colour and not so fine-grained as that of (1). The enclosed blocks vary much in size, some of them measuring 7 to 9 feet across, and many are very well striated. Lenticular sandy layers, showing diagonal bedding, and reaching occasionally 3 feet in thickness, are intercalated in the breccia, more particularly towards its base. Occasionally a layer could be seen abutting directly against one of the biggest blocks—some of which showed distinct glacial grooving.

This morainic breccia is quite indurated and forms the top of the hill. It has been itself glaciated, and shows a moutonnée surface.

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The whole series of beds now described dips towards the north, so that as we go in that direction the beds gradually descend, until the conglomerate (2) appears at the level of the river. From a point near the hill-top the two morainic breccias (1 and 8) with the intervening beds are very clearly seen, being so well exposed that no doubt as to the succession is possible.

A similar succession of beds is met with at about the same height in Hagafjall, on the west side of the hollow which separates Bringa from that mountain. It is as follows :—

	Feet.
7. Basalt	
6. Breccia (morainic?)	
5. Basalt	
4. Breccia (volcanic)	6
3. Basalt (columnar)	
2. Conglomerate	40 to 50
1. Breccia (morainic), bottom not seen	

It will be seen that from (1) to (5) this section exactly corresponds to that of Bringa already described. But the uppermost volcanic breccia of Bringa seems to be absent here. The mountain-wall, however, was inaccessible above the basalt (3), and I may easily have been mistaken as to the true character of the layer numbered (6). Should it be really a moraine, the discrepancy between the two sections might be accounted for by unequal glacial erosion. We might infer that the ice-sheet underneath which bed (6) accumulated had elsewhere (as in the Bringa section) removed pre-existing layers of rock. But should the bed in question (6) prove to be a volcanic breccia, the difference between the sections at Bringa and Hagafjall is quite inconsiderable—it is only that the upper moraine of the former does not appear in the latter.

It will further be observed that the conglomerate of the Hagafjall section is considerably thicker than the corresponding bed in Bringa. Owing to its greater accessibility it could be more readily examined (see fig. 3). It may be described as a coarse conglomerate, somewhat indistinctly bedded. It is readily distinguished from the underlying moraine, its matrix being meagre in amount, while the constituent stones are much more rounded and worn than those of the moraine, and show no striation. The greater portion of the bed consists of this coarse material. Immediately above the latter comes an inconsiderable thickness of yellowish sandstone, containing only a few pebbles, and this is followed in succession by a greater thickness of alternating layers of sandstone and gravelly conglomerate, dipping south, as in Bringa. The uppermost part of the conglomeratic bed consists of a series of pebbly

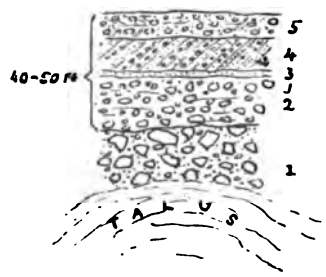

FIG. 3.—SECTION OF HAGAFJALL CONGLOMERATE.

1. Morainic Breccia: 2. Coarse, indistinctly bedded Conglomerate: 3. Thin yellowish Sandstone, with few pebbles: 4. Alternating layers of Conglomerate and Sandstone: 5. Horizontally bedded gravelly layers, showing here and there diagonal bedding.

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layers, showing here and there diagonal bedding. A thin sheet of intrusive basalt traverses the conglomerate, dwindling in thickness towards the north.

We next proceed to Gaukshöfdi, which, as already mentioned, is situated farther south than Bringa, and rises with a steep, and in part almost vertical, wall to a height of probably 300 feet above the river. The lower portion of the hill consists of a grey morainic breccia charged with blunted and striated stones. At the top of this breccia is seen a very hard, bluish-black, fine-grained rock; in this bluish-black matrix occur a few stones, some of which are well striated. This rock passes upwards into "palagonite" of a fine brown colour, the change being so gradual that it was hard to tell where the one kind of rock ended and the other began; a boulder enclosed in the "palagonite" appeared to be striated. The uppermost part of the brown breccia forming the top of the hill contains a great number of slightly subangular stones in a brown matrix. I could not satisfy myself as to the precise nature and origin of this breccia; it did not present any great resemblance to the volcanic breccias of Bringa, while it differed decidedly from the underlying grey breccia.

The surface of the breccia in question is grooved and fluted to an extent I have not seen elsewhere in Iceland, and a big erratic is perched on the slanting, northerly shoulder of the hill. On the southern slope (the lee side) of the hill there is an accumulation of unconsolidated morainic material—a bluish-grey argillaceous mass containing striated stones. Were this boulder-clay indurated, it would strongly resemble the lower moraine of Bringa. Here, as at Stórinúpur, one is struck by the insignificant amount of this moraine—a product of the last ice-sheet —when contrasted with the much more extensive accumulations of the older glaciations.

As will be seen, the two hills described, although they have much the same configuration, are yet built up in a very different way, and since the dip of the rocks is towards the north, the moraine of Gauks-höfdi probably occupies a lower horizon than those of Bringa.

Somewhat farther south we ascended the side of Hagafjall, which probably rises about 1400 feet above the river. At an inconsiderable height we saw a breccia which seemed to be morainic; it was overlaid by a sheet of basalt showing the two sets of striæ already mentioned. Farther up the mountain-slope a step or terrace is formed by the outcrop of a brown "palagonitic breccia," in which striated stones are very numerous; this breccia is exposed for a thickness of 30 to 40 feet, and is succeeded by basalt. Possibly these breccias are really portions of a single bed which has been faulted. It was evident, at all events, that portions of the mountain had subsided along lines of fracture.

A third breccia of morainic aspect was observed. Higher still appeared a "palagonite-breccia," which is probably of volcanic origin. The enclosed lumps and blocks of basalt are highly vesicular, and often so decayed that they were easily cut into with a knife. This rock was traversed in one place by a branching sheet of basalt.

The highest ridge of the mountain is moutonnée, and presents a

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great resemblance to the corresponding part of Berghylsfjall. This ridge is partly composed of grey breccia, which yielded striated stones, every stone I cut out of it being distinctly glaciated. At other parts of the ridge the rock was quite different—being brownish in colour, and containing both angular and subangular stones. Glaciated stones, however, were rare, and those observed were not very distinctly striated.

A little farther south, on the Thjórsá, one encounters low-lying masses of a fine, brown "palagonite." This rock contains, here and there, a few subangular blocks of basalt, while in some places it showed conglomerate 3 to 4 feet in thickness. I detected in the "palagonite" only one stone which seemed to have been glaciated. Two veins of basalt (2 to 3 inches and 2 feet in thickness respectively) were observed cutting the palagonite.

Making every allowance for the repetition of outcrops by faulting, it seems hardly possible that the several glaciations recorded by the indurated ground-moraines, which have now been described or referred to, can be fewer than three, and they may be four in number.

Returning now towards the north I shall record some observations made in the Thjórsárdalur (valley of the Thjórsá), which is somewhat of a misnomer. This tract lies north of the Thjórsá, west of Búrfell, and is drained, as already mentioned, by Sandá in the west and by Fossá in the east. My observations relate, of course, to the mountain-slopes that flank the valley.

In the steep side of Skridufellsfjall on the Sandá two separate layers of morainic breccia were observed—the upper one occurring at 600 or 700 feet above the river. The height of the lower moraine I have omitted to note; it consists of two layers—the lower dark grey and the upper yellowish-grey. Striated stones were readily detected; had it been otherwise, they would hardly have been found at all, for I had no time for a prolonged search. The upper moraine has a thickness of probably over 100 feet. In this rock grey portions, charged with numerous blocks, rarely exceeding 2 feet in diameter, are seen alternating with others of a more yellowish colour and containing fewer stones.

About a quarter of an hour's ride to the north-east, the Sandá is overlooked by a rocky wall, probably not much exceeding 100 feet in height. I shall not attempt to describe the truly astonishing aspect of this cliff, but will confine attention to points of special geological interest (see fig. 4). Beginning at the north end, the rock is seen to consist of a coarse breccia, the enclosed blocks frequently measuring 3 to 4 feet across. Towards the top of the cliff is a sheet of intrusive columnar basalt 4 to 5 feet in thickness (fig. 4, *a*). Where accessible this rock showed a thin tachylytic and scoriaceous crust above and below. Going southwards one comes to a mass of basalt reaching from top to bottom of the cliff (fig. 4, *b*). At its northern end, however, it is covered by the breccia; its base is not seen. This black basalt rock is not one homogeneous mass, but consists of a series of beds—vesicular and compact, and sometimes almost sandy-looking layers alternating. The beds are very nearly on end, their dip being 80° towards the east, and they strike obliquely to the direction of the cliff for a distance of about 300

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feet. The approximately horizontal layer of intrusive columnar basalt, already referred to as occurring near the top of the cliff, traverses the rock-wall from one end to the other—passing through the breccia and continuing its gently undulating course across the nearly vertical basalt beds. It is clearly an intrusive sheet, and some boulders of the breccia have been caught up in it. At the top of the cliff the dark basalt rocks, where they are not too decayed, show the two sets of striæ already mentioned as occurring at several other localities.

Though the base of this basalt-complex is not exposed, it seemed to me most probable that it is not *in situ*, but really a huge boulder. At the top of the cliff, on the south side of this supposed big erratic, the breccia shows a kind of rude bedding, which, viewed from a distance, has the appearance of a basin-shaped arrangement (fig. 4, *c*), in which the breccia is not so coarse as elsewhere. Some large blocks, however,

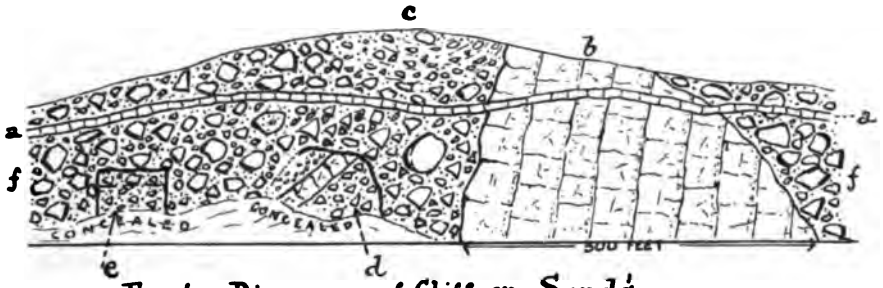

Fig. 4. Diagram of Cliff on Sandá

project from it at the moutonnée surface above, and have been thus grooved and striated by the last ice-sheet. The coarse breccia contains many blocks of a grey, indurated moraine (both of the bluish-grey and the yellowish-grey varieties to be described presently). It also includes blocks of lava that measure 12 to 14 feet in length, and having reddened, rounded stones caught up in their scoriaceous portions. These blocks are fragments of the basalt-lava which occurs in the remarkable rock mass which I now proceed to describe. A little way south from the rudely bedded breccia mentioned above we come upon a rock mass, projecting somewhat from the breccia in which it is included, and reaching a height of probably 40 to 50 feet above the river (fig. 4, *d*). Its base is not exposed. It is made up of the following layers, which are inclined at an angle of 40° to 45° towards north-east :—

	Feet.
5. Breccia, yellowish-grey 4. Breccia, dark grey 3. Breccia, bluish-grey	20 to 25
2. Basalt	20
1. Conglomerate	16 to 18 visible

The conglomerate (1) is composed of well-rounded stones of moderate size; here and there are bands of sandy clay which have been burnt to a red "brick," while the stones have been reddened to a distance of 6 to 8 feet from the overlying basalt. Quite close to the scoriaceous layer

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of the basalt—into which many rounded stones have been kneaded—the scanty, fine-grained material of the conglomerate is of a greyish colour.

The surface of the basalt (2) exhibits very distinct glacial grooving and striation passing in under the bluish-grey breccia (3), which is of the usual morainic character and only a few feet in thickness. It is very hard, and its uppermost part is made up of a succession of corrugated layers. The next succeeding layer (4) is somewhat finer-grained and darker in colour. It is followed by the yellowish-grey breccia (5) which constitutes the greater part of the rock overlying the basalt (2). This layer (5) contains towards its base a number of blocks of the underlying dark grey breccia (4), measuring up to a foot across, but with these exceptions the enclosed stones are hardly ever larger than one's fist. The rock is clearly marked off from the surrounding coarse breccia of the cliff, which is of a similar colour.

Although the base of this complex boulder or erratic was not seen any more than was that of the great basalt mass already mentioned, I could have no doubt that it was simply a large complex block enclosed in the surrounding coarse-grained breccia.

Continuing our walk southwards along the base of the cliff for a few minutes we next come to another large boulder in the breccia. It extends up to a height of 30 to 40 feet above the river, the base being concealed under talus (fig. 4, *e*). The vertical sides of this rock seem to be grooved, and it is made up of bluish-grey and yellowish-grey breccia, but here the quantity of the former exceeds that of the latter.

This was the last and the smallest of the huge erratics met with, but south of this several blocks of basalt, measuring up to 12 to 14 feet across, were seen enclosed in the breccia, together with smaller blocks of the bluish-grey breccia. Here also the coarse breccia seemed to rest upon a striated surface of basalt, the direction of the striæ appearing to be NNW. to SSE.

The intrusive sill of basalt, which I have described as traversing the cliff from end to end and cutting across the largest of those boulders (the basalt-complex), does not intersect the two smaller erratics, which occur in the lower part of the cliff, and are therefore at a lower level than the sill.

The evidence furnished by this locality as to the glacial succession in Iceland, taken together with that derived from Hagafjall, Berghylsfjall, and elsewhere, leads to the conclusion that at least three separate sheets of indurated ground-moraine occur in the tuff- and breccia-formation.

The mountains on the east side of the Thjórsárdalur are Búrfell in the south, Stangarfjall in the north, and between them Skeljafell.

At the top of Stangarfjall, probably 800 feet above the valley bottom, a bed of columnar basalt occurs, the columns having a length of 20 to 30 feet (fig 5, *a*). At the southern extremity of the mountain this basalt caps a ridge which declines rapidly to the valley in the west, and to the high-grounds in the east, above which it does not rise more than 100 feet. On the west side the basalt is seen resting on conglomerate (fig. 5, *b*). This conglomerate has previously been

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examined by Dr. Thoroddsen,[1] but probably I did not visit the precise spot described by him. The included stones are small as a rule—only few being seen which equalled one's fist in size. The conglomerate passes downwards into sandstone and a more argillaceous rock containing a few small pebbles. Some of the stones, as Dr. Thoroddsen remarks, seem to be derived from the underlying breccia. On the south-east side of the ridge I found the conglomerate underlaid by a grey morainic breccia (fig. 5, *c*), in which distinctly striated stones were observed at a depth of 60 to 70 feet below the overlying basalt bed. Farther west on the ridge appeared a very different rock. It consisted of angular and subangular blocks of vesicular basalt set in a light-coloured matrix, scattered through which were small fragments of tachylyte or volcanic glass. The whole presented some resemblance to the similar rock seen in the section on Minni Laxá (Berghylsfjall), and there could be no doubt that the conglomerate was succeeded downwards by morainic breccia.

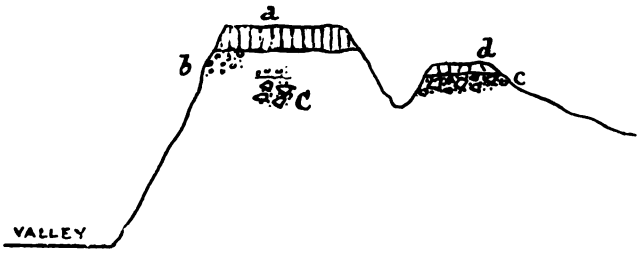

FIG. 5.—DIAGRAM SECTION OF STANGARFJALL.

To the east of the ridge referred to above, and separated from it by a gully occupied by a brook, a low rock of dolerite is seen resting on breccia (fig. 5, *d*). This dolerite in grain and colour closely resembles the so-called "pre-glacial" dolerite (that of Reykjavík, for example), and its surface exhibits clearly the two sets of ice-markings of which mention has already been made. One set consisted of broad grooves, reaching a depth of nearly 2 feet, and having a N. to S. direction. But no striæ having the same direction were observed. The grooves were crossed, however, at nearly right angles by striæ measuring ½ to 2 inches in breadth. Here, as elsewhere, the markings left by the ice-sheet that moved southwards indicated more intense grinding than those engraved by the ice that flowed towards the west. As seen in section the dolerite reaches a thickness of 6 to 8 feet, but in places it has been ground away down to the basal vesicular-scoriaceous portion—a thickness of scarcely 2 feet being left, and no doubt a great part of the rock has wholly disappeared.

The underlying breccia is grey, presents the usual morainic aspect, and contains a great number of distinctly striated stones. It includes also numerous boulders of what seemed to be a still older moraine. The

[1] Dr. Thoroddsen, "En Rejse gjennem det indre Island i Sommeren, 1888."—*Dansk. Geograf. Tidskr.*, Bd. x. p. 15.

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dolerite sends off a vesicular vein 4 feet long by 1 foot thick into the underlying breccia. (A similar vein, seen in the morainic breccia on the top of Hagafjall, perhaps indicates the former presence there of a sheet of basalt which has been entirely worn away.)

The story told by the evidence obtained in Stangarfjall may be summarised as follows:—The conglomerate underlying the columnar basalt represents an old river-channel excavated in ground-moraine before the broad valley to the west of Stangarfjall had come into existence. Perhaps the river, the work of which is here recorded, was contemporaneous with the watercourses represented by the conglomerates in Bringa-Hagafjall and Galtafellsfjall (Núpstúnsfjall). Eventually the old valley was invaded by a great lava-flow underneath which the river-gravels were entombed. Thus protected, the old river-bed has escaped denudation and now enters into the formation of a prominent ridge. It would appear, however, that the valley to the west of this ridge is in great measure due to subsidence rather than to erosion. But the hollow lying on the east side of the ridge is a hollow of erosion, and into it flowed a stream of doleritic lava. At a later period the whole country was overwhelmed by an ice-sheet—and this glacial invasion may have been repeated oftener than once.[1]

According to Dr. Thoroddsen the mountain-slope that overlooks the broad valley (Fossalda) on the west shows the same geological succession as Stangarfjall, consisting as it does of dolerite resting on "palagonite-breccia." This strengthens the conclusion that the subsidence to which the valley mainly owes its origin took place after the formation of the columnar dolerite. Possibly the subsidence may even be of later date than the effusion of the dolerite which I have described as lying to the east of the ridge. It would seem that the great plateau has experienced towards the north-east successive collapses of this kind. Close to the west of the place, where the Fossá in a magnificent fall plunges down from the plateau, the mountain-side appears to have subsided along a series of concentric and radial faults after the last ice-sheet had melted away from the district. The scene is one of an indescribable rugged grandeur. The presence of the gigantic blocks in the morainic breccia on the Sandá, as described above, becomes more intelligible and less surprising when we keep in view the probability that such shattered rock-masses or mountain-fragments may have lain in the path of the crushing and grinding glacier.

Unfortunately time did not allow me to visit this place—the so-called "Hrun"—last summer. I had seen it some years ago, but I was then unacquainted with glacial phenomena.

According to Dr. Thoroddsen, the columnar dolerite which is so well seen in Stangarfjall, can be observed also in the imposing cliff behind the fall of the Fossá, and Mr. P. Lýdsson informs me that the rock on which the dolerite rests is very similar to the morainic breccia in Stangarfjall.

[1] It is probable, as I shall try to show in the sequel, that the columnar basalt of the ridge had been subjected to glaciation before the eruption of the dolerite which occupies the hollow to the east of the ridge.

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Leaving Stangarfjall and passing southwards along the east side of the valley, we come to Skeljafell, where the Fossá is nearest to it. The rock here is a brownish-yellow breccia, composed of blunted stones of variable size. It has quite a morainic appearance, but no striated stones were observed. It closely resembles the lowest rock of Búrfell, which I shall presently describe.

The mountain of that name rises with bare rocky steeps to a height of 1450 feet above the river. On the north side, however, it is not precipitous. I ascended it from the west, and at a height of about 400 feet above the Thjórsá, encountered an extremely hard, grey breccia, with blunted stones of varying size and aspect. Distinctly striated stones were detected, but they did not seem to be numerous. Higher up and farther south I noticed a brown breccia, apparently volcanic, which was overlaid by a bed of morainic breccia, the latter in its turn being covered by a brown-coloured rock. These rocks, however, were so difficult to get at that I could not examine them satisfactorily.

The breccias referred to are succeeded by basalt, probably 150 to 200 feet in thickness, and supporting a much jointed grey breccia some 100 feet or so in thickness. The joints cut through stones and matrix alike. When, after some ineffectual attempts, I at last got to the top of the basalt, this breccia proved to be one of the most markedly morainic accumulations encountered in the course of my wanderings. Towards the base it is very stony, with big, blunted blocks, none of which, so far as I saw, showed any distinct striæ. A little higher up in the bed, however, any number of striated stones appeared—blocks of a compact, black basalt, exhibiting the finest glacial polish one could wish to see. The rock contained also some boulders of what I took to be morainic breccia of a different colour. A comparatively small portion of the breccia was of a brown colour, and contained slightly subangular stones. This brownish-coloured rock reminded me of certain "palagonite-breccias" which I had supposed were of volcanic origin. On a narrow shelf of basalt, projecting from below the breccia, distinct ice-markings were observed, the direction of the striæ being N. to S. There can be no doubt that this characteristic morainic deposit rests upon a striated surface. Mr. P. Lýdsson, who visited the place later in the autumn, informs me that on the east side of Búrfell a sheet of moraine, which he thinks is the same bed as that just mentioned, can be seen resting on a very thick basalt, underneath which occurs a brownish-yellow moraine. He has sent me a finely glaciated stone which he extracted from the latter.

Unfortunately I did not succeed in climbing to the top of the mountain, and I had no time to attack it from the north. The grey moraine which, as I have said, rests on a striated surface, seems to be overlaid by at least 200 feet of basalt. Probably the united thickness of the beds above that striated surface is about 700 feet.

According to Dr. Thoroddsen, a red breccia appears on some of the highest parts of Búrfell. Of the nature of that breccia, however, I can say nothing.

The lowest rock I observed in Búrfell was a breccia of morainic

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aspect, capped by a layer of glaciated basalt at a height of 100 feet above the river. Save for its colour, which is more decidedly grey, this rock reminded me of the lowest breccia of Skeljafell already described. Like it, too, the lower breccia of Búrfell appeared to contain no indubitably striated stones. The base of the mountain advances nearer to the river here than elsewhere, and I did not forget the possibility of the breccia having been brought, by subsidence, into its present position. It is remarkable, however, that the lower breccias differ always, more or less, from the upper beds. Although the former have a morainic character, yet they seldom or never yielded striated stones, while the reverse was the case with the upper breccias.

The grey-coloured indurated ground-moraine (100 feet thick) in Búrfell is conspicuous from a considerable distance, and dips gently towards the north. It seems to be continued in Skeljafell to the north. The moraine that underlies the conglomerate of that mountain occurs at a somewhat higher level, probably owing to the existence of transverse faults. I am inclined to think that the 100 feet moraine of Búrfell corresponds to the lower moraine of Bringa, and to the middle moraine (80 to 90 feet thick) of Midfellsfjall.

Imperfect though they be, I hope that these notes on the mountains that flank Thjórsárdalur will suffice to show that this district—long famous for its scenery, volcanic phenomena, and archæology—is of no little interest likewise from the point of view of glacial geology.

On the way back to Reykjavík a few additional observations were made, of which the following may be mentioned. Hestfjall is an isolated mountain rising out of the lowland at a bend of the river Hvítá. Near the ferry of Árhraun the rocks on the river consist of morainic breccia with blunted stones, but no striated stones were seen. This breccia seems to be the lowest rock of Hestfjall, which at that locality consists chiefly of brown, stratified tuff. A little to the north of the mountain I noted low rocks of a grey breccia, containing striated stones. Rocks of a similar breccia were also seen near Kidjaberg, to the west of Hestfjall, and in one place post-glacial marine deposits were observed resting on a striated surface of indurated moraine.

Hellisheidi is the name of a highland tract which rises precipitously above the country to the east and west. It is clearly of the nature of a "Horst," and the lower land to the west of it is largely covered with lavas which exhibit ice-worn surfaces. The main road from Reykjavík to the southern lowland traverses this tract. A short distance from Hveradalir (the valleys of the hot springs) a steep rock on the roadside consists of breccia, in which I found a distinctly striated stone. Probably further investigation will show that the breccia of Hellisheidi is largely of glacial origin.

The observations which I shall now mention relate to glaciations of a more recent date than those whose records are seen in the so-called "palagonite-breccias."

The two sets of striæ of which I have several times spoken are not uncommon in the region to the east of Stóra Laxá, and seem to occur between Hvítá and that river, but west of Hvítá, in the district of

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Biskups-Tungur, they were not observed. The system having a direction mainly S. is everywhere seen to be the older. The trend of the younger set varies a few degrees on both sides of W. The older striæ are beautifully preserved on what are lee-sides with respect to the westward movement. I have already mentioned some of the localities where these two sets of striæ are seen, and shall only add that on the hill called Króksholt south of Hlídarfjall, and on every bare rock for a long way south of it, the two systems can be distinctly observed. We may note, for example, how the back of many a rocky ridge is striated from east to west, while the flanks are fluted from north to south.

Deflection was more characteristic of the younger than of the older system of striæ. This fact, taken in connection with the greater degree of erosion that accompanies the older system, seems to show that the southward moving ice-sheet was more important or thicker than the other. That the thickness of the latter, however, was by no means inconsiderable is shown by the fact that the ice has flowed right across well-marked inequalities of the ground—traversing ridges and hollows alike.

Certain observations made near Reykjavik tend to confirm me in my opinion that Iceland has experienced more than one general glaciation after the outpouring of the doleritic lavas. At Sudurnes—the farthest westward projecting point of the peninsula, on which is situated the town of Reykjavík—a greyish-brown ground-moraine with striated stones, nearly as completely indurated as many of the "palagonite-moraines" described above, can be seen resting on striated dolerite. About 1½ feet from its base the moraine becomes finer-grained and harder, and the surface of this harder portion is distinctly smoothed and striated. About 1½ feet higher there seems to be another striated floor overlaid by more stony moraine (4 to 5 feet). Throughout the whole morainic series much triturated shell-débris occurred. The moraine is washed by the sea at high water.

Loose débris of glacial origin is usually scattered over the dolerite around Reykjavík, but nowhere else save at Sudurnes have I seen the dolerite covered by a moraine of the kind described. Judging, however, from the occurrence of loose blocks, patches of a similar rock will probably be found at Øskjuhlíd (hill near Reykjavík) and at Valhús near Sudurnes, and elsewhere.

Especially interesting was a glaciated lava-stream observed at several places in the neighbourhood of the farm of Vatnsleysa, about two miles (Dan.) south-west of Geysir. By far the greater part of this lava-stream is concealed under marine deposits and peat, etc., but it is exposed on the river Tungufljót; and about an hour's ride north-west of Valdavad, where the river is forded, a considerable stretch of highly glaciated and boulder-strewn lava is to be seen on the east side of the river. This doleritic lava is the only glaciated lava-stream known to me, resting on apparently marine deposits, which closely resemble those so commonly met with in the southern lowland. The superposition of striated lava upon gravel and clay can be observed on both sides of Tungufljót, but it can be studied most satisfactorily in the eastern wall of the ravine below the waterfall—which, it may be added, owes its origin to this

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superposition. The surface of the sedimentary deposit underlying the lava is very uneven; in places the lava even descends to the river, while elsewhere the sedimentary strata attain a visible thickness of hardly less than 20 feet. At their contact the two rocks are kneaded together in a most remarkable manner, and small pebbles are enclosed in the lava, which towards its base presents a honeycombed aspect, containing in the very irregular cavities a red, earthy matter. The following section may be given:—

	Feet.
d. Glaciated lava, ...	3 to 4
c. Sand and gravel, undisturbed, . .	8 to 10
b. Laminated clay, folded and contorted, .	4 to 5
a. Laminated clay, undisturbed, . .	4 to 6

The clay (*a*, *b*) is somewhat indurated and the stratification very well marked, darker and lighter-coloured layers alternating. The dolerite (*d*) is here very thin, having apparently been ground away by the ice down to its undermost vesicular layer. The direction of the striæ is SSW. to SW., and no traces of an E. to W. system were observed.

On the left bank of the river, a short distance above the waterfall, laminated clay overlies the striated lava. This succession, however, is not actually seen in the section to be described, as the bottom of the clay is not exposed. There can be no doubt, however, as to the relative position of the beds, for only a few minutes' walk down stream the lava in question occupies the bed of the river. The clay seen above the waterfall has a visible thickness of 8 to 10 feet. Rounded stones occur in the soil above it. This clay is softer than that underlying the lava, and is very well stratified. Towards the top and the bottom the layers are violently contorted—a structure which is rendered very apparent on account of the several layers being differently coloured. The disturbed portions are separated by a few feet of totally undisturbed clay (see fig. 6).

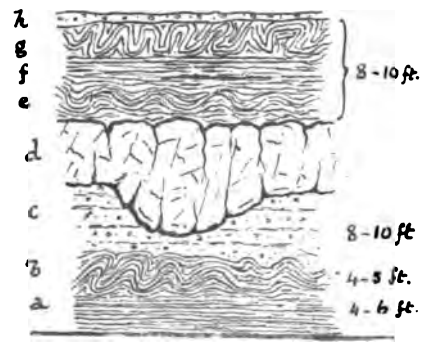

FIG. 6.—DIAGRAM SECTION ON TUNGUFIJÓT.

a. Clay-beds, horizontal: *b*. Disturbed beds of sand, etc.: *c*. Horizontal beds of sand and gravel: *d*. Lava with glaciated surface: *e*. Contorted clays: *f*. Undisturbed clay: *g*. Highly contorted beds: *h*. Gravelly subsoil.

Such disturbances—though rarely, if ever, so striking as here—were commonly observed in sections of the "post-glacial marine deposits" of the southern lowland. Sometimes, too, striated boulders, and in one case a completely angular block, with remains of balani attached to it, were found imbedded in the post-glacial clays. These phenomena would seem to indicate the existence of icebergs or rafts in the post-glacial sea. And seeing that the deposits underlying the glaciated lava on Tungufijót closely resemble those of unquestionable marine origin, one is naturally led to infer a similar

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origin for them, and to conclude that the contorted structure referred to may be due to the action of floating ice.

As indicated above, the clay passes upwards into sand and gravel, while the lava rests upon the uneven surface of these deposits. These facts lead one to infer that the lava was erupted after elevation of the sea-floor had taken place. If this has been the case then it would follow that the land must have been submerged and re-elevated subsequently to the outflow of the glaciated dolerite. But for this lava, which has protected the underlying soft beds, we might never have had any record of these interesting oscillations of level. The lava in question seems to accommodate itself to the form of the ground in a more intimate manner than the "pre-glacial" dolerite of Reykjavík, and possibly, therefore, it may be of more recent date. But as I do not know, even approximately, how far it extends, I am unable to offer any opinion upon the question of its probable age.

In the summer of 1897 I observed near Godhavn in the island of Disko, Greenland, a well-developed terminal moraine, indicative of a more severe glaciation than that now obtaining in the island; and a lateral border-moraine which bears testimony to still more marked glacial conditions, and is demonstrably older than the terminal moraine.[1] Possibly these morainic accumulations are not moraines of retreat, but represent glaciations corresponding in age to those which have left their markings on the above described dolerite of Stangarfjall.

III. A Few Conclusions.

I shall not be surprised if this account of the occurrence of glacial deposits and striated rock-surfaces in connection with the "palagonite-formation" of Iceland is received with incredulity. For myself, I could hardly believe the evidence when I first encountered it, and tried to explain it in every possible way other than by glacial action. But the glacial origin of the "breccias" could not be gainsaid. Not only did they present a characteristically morainic aspect, but they yielded numerous well-striated stones, and in places were found to be resting upon grooved and striated rock-surfaces. If the observations I have here recorded be accepted as fairly trustworthy, we cannot avoid the conclusion that glacial deposits, hitherto unrecognised as such, are largely developed in Iceland, or at all events in that part of the island which I have critically examined and referred to in these pages.

As I have had only a glimpse, as it were, into this very promising field of glacial research, I shall not attempt to deal with the glacial succession in Iceland. That must be left for future investigations to determine. Nevertheless there are several conclusions which seem to me obvious enough. Of these the most important in my opinion is that which has reference to successive glaciations. The facts advanced show that Iceland has experienced more than one glaciation before the ejection of the doleritic lavas and their subsequent smoothing and grooving by

[1] *Meddel. om Grönland*, vol. xiv., 1898, p. 297-301.

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ice. How many separate glaciations the morainic breccias bear witness to is uncertain. But the repeated occurrence of four separate sheets or beds of morainic breccia seems to render it not improbable that there have been just as many separate glaciations during the accumulation of the so-called palagonite-formation. Even if we discard the evidence furnished by the lowest breccias (in which, it will be remembered, that notwithstanding their morainic aspect, no striated stones occurred), we have still the overwhelming evidence of glaciation supplied by the higher morainic breccias. But whether these indurated ground-moraines represent three, four, or more glaciations, one or other of them must represent the epoch of maximum glaciation in Europe. The glaciation which left the older system of markings on the dolerite of Stangarfjall is of course of later date and may possibly represent the Mecklenburgian stage (Geikie) of Northern Europe, and the "first post-glacial stage of glaciation" of the Alps (Penck). It seems more than probable that a change of climate, corresponding to that which in the Alps depressed the snow-line about 3000 feet, would bring about the total glaciation of Iceland. Indeed, a much less important change in the climatic conditions would suffice to do this. It is therefore quite possible that the younger system of striæ marking the surfaces of the dolerites may be contemporaneous with that re-advance of cold conditions which produced the local glaciers of the "Lower Turbarian stage" of Scotland, and those of the "Second Post-glacial stage" in the Alps.

[The second striated horizon in the moraine of Sudurnes (if it be not a striated pavement) may possibly indicate a third "post-doleritic" glaciation, but until additional evidence be forthcoming, this isolated observation must be left out of consideration.]

So far as I know, all that has been written on the glacial period in Iceland refers to the minor glaciations which supervened after the ejection of the doleritic streams of lava. I say minor glaciations even although the country appears during those stages to have been totally ice-covered. But the mass of the "palagonite-moraines" is so very much greater than that of the loose accumulations of the later glaciations, that we may reasonably infer that the former are the products of much greater ice-sheets. Moreover, the conditions of erosion and accumulation during successive glaciations seem to have differed at the same localities. Further, when we remember that the whole region throughout which the palagonite-formation occurs has been extensively fractured and consequently has experienced many subsidences—and when we reflect that all these important deformations of the land-surface took place subsequent to the accumulation of the uppermost morainic breccias, we are led to suspect that the area over which the older glaciations prevailed may have considerably exceeded that which now exists. Probably conclusive evidence on this point may be obtained by studying the directions of the oldest glacial striæ all over the country, and more especially in the north. Unfortunately, however, the striæ in question are not very likely to be accessible in many places.

It would probably also be of great interest to determine the relations of the pliocene shell-beds near Húsavík, North Iceland, to the "tuff- and

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breccia-formation." As I have obtained a grant from the Carlsberg Fund, Copenhagen, to enable me to continue these investigations, I hope to do so on the lines here indicated.

About 5500 square miles of the total area of Iceland are at present covered with glaciers.[1] The country, therefore, would seem to be in a state of glaciation comparable to that obtaining in Scotland during the fourth glacial epoch as defined by Professor Geikie. Now, if Iceland were to be once more totally glaciated, should we term that final ice-invasion a separate stage of glaciation, or merely an oscillation of the existing glaciers? Would the present inhabited condition of Iceland be considered an inter-glacial epoch, or merely a stage of temporary glacial retreat?

Such consideration must be kept in view when we are discussing whether the old ground-moraines described in this paper have been laid down by an oscillating ice-sheet or during separate glacial epochs.

In Búrfell two bottom-moraines are separated by 150 to 200 feet of basalt on the striated surface of which the upper moraine reposes. Possibly, however, that basalt does not mark the lowest inter-glacial horizon.

To the next succeeding inter-glacial horizon probably belong the conglomerates of Stangarfjall, Bringa, and Hagafjall, which are supposed to be of fluviatile origin. Perhaps also the columnar dolerite of Stangarfjall should be included here. The existence of those conglomerates at such heights and so far inland suggests at least a very considerable oscillation of the ice-sheet. Moreover, we must not forget that the conglomerates in question are buried underneath masses of various volcanic products. [While some of the old gravel-beds may well represent old river-channels, in other places, as in Hagafjall and Bringa, they had more the character of lacustrine deltas or *cônes de déjection.*]

The next interval between two glaciations is that marked by the so-called "pre-glacial dolerites," which henceforward cannot claim to be more than inter-glacial. "At the time these pre-glacial lava-beds were laid down, the country had pretty much the same essential contours that it has at present."[2] But when the uppermost of the "palagonite-moraines" (as in Berghylsfjall and Hagafjall) were laid down, the relief of the country as we have seen differed greatly from that which now obtains. In the interval of time that separates these morainic breccias from the eruption of the later lavas, the most radical changes in the contours of the country had been effected, chiefly perhaps by subsidence. The southern lowland of Iceland cannot date farther back than this inter-glacial epoch.

It is not improbable, indeed, that the essential contour-lines or surface-features of the whole island, so far as these are older than the later outflows of dolerite, came into existence during this inter-glacial epoch. We cannot tell at what particular stage the later dolerites were erupted, but we know that the changes of relief which were effected during the inter-glacial stage in question were very much greater than those which

[1] Thoroddsen, *Explorations, etc.*, p. 42.
[2] Thoroddsen, *Explorations, etc.*, p. 35.

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have taken place since the outflow of the doleritic lavas. And yet these lavas have been glaciated more than once, and we do not know how long they had to wait for their first glaciation.[1]

We seem therefore justified in coming to the conclusion that the two glaciations in question have not been the result of comparatively insignificant oscillations of an ice-sheet, but were really separated by a protracted period. The very occurrence indeed of the inter-glacial streams of lava over such great areas suffices to show how extensively the ice-sheet melted away. It seems to me highly probable, that *all* the so-called "pre-glacial" lavas are in reality inter-glacial.[2]

Furthermore, the evidence leads to the inference that the time which has elapsed since the last ice-sheet disappeared from the southern lowland of Iceland, is very short as compared to the inter-glacial epoch that intervened between the first of the glaciations experienced by the dolerites, and that next preceding it.

Whether the supposed marine deposit which underlies the glaciated lava on Tungufljót dates back to the closing stages of the inter-glacial epoch just mentioned, or whether it ought rather to be ascribed to an interval separating the two glaciations which are represented by the two systems of striæ upon the surfaces of the later dolerites, future investigations must be left to determine.

No doubt many additional conclusions are suggested by the observations recorded in this paper, but I do not care to consider these at present. As already stated, the chief object of this paper is to point out that there exists in Iceland much hitherto unsuspected evidence of former glacial action. I am indeed sanguine enough to think it is not improbable that the records of the glacial period have been more fully preserved here than elsewhere. For it is obvious that the conditions for the protection and preservation of glacial deposits have been with us somewhat exceptional. While in other lands, free from volcanic activity, each succeeding ice-sheet has partly destroyed and partly covered up the deposits of its predecessor, in Iceland the moraines have been greatly sheltered by the products of volcanic eruptions which overlie them. Moreover, crustal movements have contributed directly towards the same end by placing the old moraines beyond the reach as it were of succeeding glacial invasions. Not improbably, too, some rocks of the "tuff- and breccia-formation" may be due to the direct interaction of volcanic and glacial forces.

The important part played by volcanism as a conservator of the Icelandic glacial accumulations is evidenced by the fact that the "tuff- and breccia-formation" is mainly confined to that belt of the country which has continued to witness volcanic activity ever since Tertiary

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[1] So far as I am able to judge, the columnar dolerite overlying the conglomerate of Stangarfjall is not to be confounded with "the pre-glacial dolerites" but belongs—together with the underlying conglomerate—to the next preceding inter-glacial epoch. It is also clear that at the time this rock was formed, the relief of the country was widely different from the present, what is now the top of a mountain-ridge being then the bottom of a river-channel.

[2] By means of the inter-glacial lavas it might perhaps be possible to ascertain whether the glacial covering of Iceland was less extensive at the time of their eruption than it is now.

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times. It would certainly be astonishing if the "palagonite-moraines" were totally absent outside this belt, but such is not the case. From the maps and scientific communications of Dr. Thoroddsen, we learn that patches of the "tuff- and breccia-formation" occur at several places throughout the basaltic areas of Iceland. But with these exceptions, the areas referred to appear to have been stripped of their older moraines.

In the description of his travels in south-eastern Iceland in the summer of 1894, Dr. Thoroddsen remarks: "In the course of this journey it became clear that the palagonite-breccia to the north of Vatnajökull has a much greater extension towards the east than one had at first supposed. I have before shown that in the west of this country the great breccia-formation is younger than the basalt, and this is confirmed here, the breccia and tuff everywhere being found to rest on the basalt. . . . At several other places also small, thin patches of breccia can be observed overlying the basalt."[1] This is near the east coast. In the west of Iceland isolated patches of breccia resting on basalt also occur, as, for example, at Strútur, Vikrafell, and Sandfell. And seeing that the "tuff- and breccia-formation" likewise puts in an appearance, both in the extreme north and the extreme south of the country, we could hardly expect better evidence of the former wide extension of our glacial formation. But in the basalt regions, where the moraines were not protected by overlying volcanic rocks, they were naturally subjected to the repeated attacks of the ice-plough, while it is obvious that they could not escape the denudation carried on during inter-glacial epochs.

I have examined but a relatively limited portion of the area occupied by the "palagonite-formation," and it is conceivable that this formation may have a different character in the districts I have not visited. Even were this the case, however, it could not affect the evidence which I have adduced. But it is in a high degree improbable that the glaciations, of which the "palagonite-moraines" are the records, could have been restricted to those places only where these moraines are now met with. And, therefore, I fully expect to find that indurated ground-moraines will prove to be of common occurrence in other regions where the "palagonite-formation" has been detected.

In part proof of this I may mention that my friend Mr. Páll Lýdsson has met with what he takes to be a "palagonite-moraine" at several places in the narrow and deep valley of the Thjórsá called Gljúfurleit, about four or five (Danish) miles to the north-east of Búrfell. He makes special mention of a sheet of morainic breccia reaching a thickness of probably 200 feet, and resting on columnar basalt, the fine columns of which measure 30 to 40 feet in length. Again, turning to the literature of the subject, I find that the breccia of the Strútur, in the west of Iceland, is described by Thoroddsen as "of a greyish colour and poor in palagonite; only a few reddish-brown portions are seen; now and again also a fine-grained, stratified tuff."[2] Further, in a very

[1] *Dansk geograf. Tidskrift*, Bd. xiii. p. 203.

[2] Thoroddsen, "Geolog. Iagttag. paa Snæfellsnes i Island."—*Bihang till K. Svenska Vet. Akad. Handl.*, Band xvii. Afd. II., No. 2, p. 33-4.

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interesting report on his travels in Vesturskaptafells-sýsla, South Iceland, in 1893, the same author gives a detailed account of the palagonite-formation. He remarks that in extensive exposures and long natural sections in the regions occupied by the tuff- and breccia-formation, the breccias over wide areas are sometimes crowded with very large, angular blocks of basalt irregularly distributed through the rock. "One may suppose," he says, "that the explosions by which fragments of such a size were scattered broadcast over areas so extensive must have been much more energetic and powerful than those which take place nowadays. It is conceivable also," he continues, "that the blocks may have been distributed by some other agency. But they give no indication of having been transported either by ice or water."[1] This description, so far as it goes, would apply very well to large portions of the section exposed in Sandá, but the breccia seen in that section is beyond doubt a true bottom-moraine.

In 1883 the well-known German glacialist, Dr. K. Keilhack, visited Iceland and made a number of very valuable observations on the geology of the island. With reference to the conglomerates which occur in the south of the island, near the Eyjafjalla and the Mýrdalsjökull glaciers, he writes as follows:—"In many places in Southern Iceland the Miocene contains true conglomerates, in which occur blocks exceeding a cubic foot in size. The structure of these coarse accumulations reminds one of that of the Icelandic glacial formations, to which they have an extraordinary resemblance. One sees imbedded in a firmly cemented ground-mass blocks of all sizes lying higgledy-piggledy. And so greatly does the structure recall that of recent terminal moraines that it is only when we remember that the cementing material of the conglomerate is tachylytic, and that the overlying strata, hundreds of mètres in thickness, consist of a great succession of basalts and bedded tuffs, that we can avoid thinking that these completely structureless masses are the products of glacial action." Dr. Keilhack rejects the hypothesis that these "conglomerates" are deep-sea deposits, and is of opinion that they have either been accumulated along the coasts of a shallow sea, to which volcanic ejecta have been carried down in the form of rolled stones and fine-grained materials, or they are simply river-deposits, which, he thinks, is perhaps the more probable conclusion, seeing that the formation contains no traces of a marine fauna.[2]

In the report on his travels in Vesturskaptafells-sýsla, referred to above, Dr. Thoroddsen records some further observations on similar conglomerates, and remarks that "in these conglomerates, old and young alike, the boulders are rarely so well rounded as those of the rivers or the sea-beach; but they present," he continues, "a greater resemblance to morainic material which has been partly rounded by the action of glacier-brooks."[3]

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[1] *Dansk geograf. Tidskrift*, Bd. xii. p. 201.

[2] Keilhack, "Beiträge zur Geologie d. Insel Island."—*Zeitschr. d. deutsch. geol. Ges.*, Bd. xxxviii. (1886), p. 384-5.

[3] Thoroddsen, *Dansk geograf. Tidskrift*, Bd. xii. p. 203.

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The rocks thus described by Dr. Keilhack and Dr. Thoroddsen seem to differ considerably from the conglomerates observed by me last summer. But the descriptions given by those authors [1] would apply very well to such a rock as the lower moraine of Bringa or to the 100 feet breccia of Búrfell, which, it will be remembered, rests upon a striated surface of basalt.

Dr. Thoroddsen does not agree with Dr. Keilhack in ascribing to these conglomerates a Miocene age, but is inclined to the opinion that they are much younger. According to him the conglomerates seem to have been accumulated not long before the glacial period and under wet climatic conditions.[2]

Although Dr. Keilhack was much struck with the morainic aspect of his conglomerates, he plainly rejects the idea of their glacial origin. I can hardly do so, for I have seen rocks which, so far as I can judge from the descriptions by Dr. Keilhack and Dr. Thoroddsen, are of similar character to the "conglomerates" examined by them, and yet the rocks I refer to rest upon a surface which is as distinctly glaciated as any of those I have seen along the margin of a modern glacier.

Although my conclusion as to the glacial origin of a part of the "palagonite formation" originated in the field, and was as far as possible from being suggested by anything I remembered to have read in works treating of Icelandic geology, yet I am quite willing to admit that the observations of Dr. Keilhack, referred to above, might well have formed the starting-point of some such theory—indeed, they might have done so any time within the last seventeen years.

Hitherto it has chiefly been volcanic Iceland which has received the attention of geologists. It is to be hoped that many will be able ere long to satisfy themselves by visiting our country that glacial Iceland is not less deserving of study.

In conclusion, I desire to express my heartiest thanks to those who have encouraged and helped me in my work, among whom I would specially mention Professor N. V. Ussing of Copenhagen. To Dr. Thoroddsen I am also indebted for his kindness in placing some of his journeying outfit at my disposal last summer. I am grateful, too, for the kindness which I have received from geologists and others since I came to Scotland. Professor Geikie and Messrs. Peach, Horne, and Goodchild of the Geological Survey have shown me much attention. I am also deeply indebted to Mr. A. Mackinnon, to Mr. W. Campbell of Tullichewan Castle, and last, but not least, to Mrs. Disney Leith of Westhall, who, among other things, was kind enough to help me with my English while preparing a part of this paper.

I shall only add that Professor Geikie has been good enough to revise my manuscript, and to help me over the difficulties which beset one who attempts to express himself in a language with which he is not thoroughly familiar.

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1 They make no mention, however, of striated stones as occurring in the conglomerates they examined.

2 *Dansk geograf. Tidskrift*, Bd. xii. p. 203.

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THE RECIPIENTS OF THE SOCIETY'S MEDALS.

Captain ADRIEN DE GERLACHE of the *Belgica*.—Born at Hasselt in 1866, Adrien de Gerlache early gave evidence of an irresistible inclination to a seafaring life. After a wide and adventurous experience before the mast, he became an officer with a large Dutch line, and later with the Dover and Ostend packets. The idea of an Antarctic expedition gradually took strong hold of him, and his proposals met with the support of the Geographical Society of Brussels. While the funds were being raised by national subscription, Captain de Gerlache joined a Norwegian whaler for a voyage to Greenland and Jan Mayen. The

CAPTAIN ADRIEN DE GERLACHE OF THE "BELGICA."

following winter was spent in the equipment of the *Belgica*, a small whaler of 260 tons, in consultation with Nansen and other polar explorers, and in arranging the staff of the expedition, which consisted almost equally of Belgians and of Scandinavians.

Lieutenant GEORGES LECOINTE of the *Belgica*.—Born at Antwerp in 1869, M. Lecointe was educated at the military schools, and became Lieutenant of Artillery in 1894. In the same year he entered the French Naval Service, and joined the Eastern Mediterranean squadron. Having served, in the following years, both on the Atlantic station and at Cochin China and Tonkin, he was appointed, in June 1897, to the second command of the Belgian Antarctic Expedition, taking at the same time special charge of the hydrographical and astronomical observations, to which he added the magnetic and pendulum work after the

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death of Lieut. Danco. Lieut. Lecointe has published the following works:—*La Navigation astronomique et la Navigation estimée; La création*

LIEUTENANT GEORGESG LECOINTE OF THE "BELICA."

PROFESSOR CHUN OF THE "VALDIVIA."

d'une marine nationale Belge; Note à l'Académie concernant les observations magnétiques recueillies dans l'Antarctique; Voyage d'hiver en Patagonie, notice

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preliminaire communiquée à la S.R.B. de Géographie de Bruxelles. Also several maps. Last year Lieut. Lecointe travelled from Santa Cruz up to Lakes Argentino and Viedma, in winter.

Professor CHUN of the *Valdivia*, the distinguished Professor of Zoology at Leipzic, was appointed Director of the expedition on account of his position as a leading authority in deep-sea research.

Captain ADALBERT KRECH of the *Valdivia*.—Born in 1852, Captain Krech was for many years engaged in whaling, and later entered the Turco-Roumanian service, where he received decorations from the Sultan

CAPTAIN ADALBERT KRECH OF THE "VALDIVIA."

and from the King of Roumania. For his bravery in rescuing the crew of the American ship *Mary E. Emsten* in 1894, in the North Atlantic, he received a gold medal from the Emperor of Germany, a gold cup from President Cleveland, and a decoration from the King of Saxony. He has been for many years a well-known Commander in the service of the Hamburg-American line, and was selected by the Directors to take charge of the scientific expedition in the *Valdivia*.

THE BELGIAN ANTARCTIC EXPEDITION.

To Adrien de Gerlache and his gallant companions of the Belgian ship *Belgica* belong the honour and credit of being the first to carry out a complete series of scientific observations, throughout the entire year, in the Antarctic regions, besides making valuable collections of animals,

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plants, rocks, and the like. To the perseverance and energy of M. Gerlache the origin and work of the expedition are due. The reports and collections are such that two or three years must elapse before their study is completed. Thanks to the foresight, intelligence, and liberality of the Belgian Government, the publication of these reports is assured, a commission having been appointed to organise and direct the work. Any account given now is therefore merely of a preliminary nature gleaned from reports already published.

Beside M. Gerlache, the leader, accompanying him were Georges Lecointe, who had charge of the hydrographic and cartographic departments. Émile Danco was the magnetist; he also undertook the pendulum observations. After his untimely death early in 1897 his work was continued by Georges Lecointe. Émile Racovitza was zoologist and botanist. Henri Arctowski and Antoine Dobrowolski were the meteorologists. Arctowski also undertook oceanographic and geological researches. Frederick A. Cook was medical officer and photographer.

The *Belgica* is the first scientific expedition that has explored the north-west of Graham's Land with its islands, inlets, and channels. Ross and D'Urville mapped out the north-easterly portion of this same land, which appears actually to be part of Antarctica itself, fringed with numerous islets. These three are the only purely scientific expeditions that have visited this part of the Antarctic regions, though it may be remembered that an artist and three scientists from Scotland joined the Dundee whaling and sealing fleet that visited Erebus and Terror Gulf in search of bowhead whales in 1892-93, on the chance of doing whatever artistic and scientific work was possible. During this time they took as many observations as the extremely trying and disadvantageous circumstances permitted.[1] A large and very beautiful series of pictures were brought home, while very complete records in meteorology from observations taken every two hours were secured. Several deep-sea soundings and temperatures, surface salinities and temperatures, and plankton and other collections were made. A new channel, the Firth of Tay, was discovered and mapped, and about sixty or seventy miles of the eastern coast, of what is now known as Danco Land, was roughly placed on the chart.[2]

The *Belgica* left Staten Island on January 13th, 1898, and steered a course almost due south for the South Shetland Islands. The first iceberg was sighted on January the 19th, and next day Livingston and Smith Islands were sighted on port and starboard bows respectively. During misty and unsettled weather in this neighbourhood the vessel narrowly escaped being wrecked, having struck on a rock. Sail Rock was next sighted, and the following day, during a violent storm, Wencke, a young sailor, was washed overboard and drowned. A rest was then

[1] Vide *Scot. Geog. Mag.*, vol. x. No. 2, pp. 57-62, "The Story of the Antarctic," by W. S. Bruce (naturalist); *Ibid.* pp. 62-69, "The late Expedition to the Antarctic," by Dr. C. W. Donald. Vide *From Edinburgh to the Antarctic*, by W. G. Burn Murdoch, Longmans & Co., etc., etc.

[2] *Vide* British Admiralty Chart, No. 1238, corrected, x. 93. *Vide* also sketch by W. G. Burn Murdoch, in *Scot. Geog. Mag.*, vol. x. No. 2.

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made for a night under the lee of Low Island, and next day Bransfield Strait was crossed. The first landing on a small island was then effected in the vicinity of what has been known as Hughes Gulf, and an opening into the land was discovered which afterwards proved to be a strait running SW. and NE., opening by its SW. end into the Pacific Ocean, and by its NE. end into Bransfield Strait. This strait Gerlache has named Belgica Strait after his ship, and the group of islands cut off by it Palmer Archipelago, after Captain Nathaniel Palmer, the first discoverer of the land. The mainland, an extension northward of Graham's Land, he has called Danco Land, after Lieutenant Danco, who died during the drift which followed M. Gerlache's discovery of Belgica Strait. After passing out at the SW. end of this strait, M. Gerlache tried to follow the mainland southward, but the pack-ice forced him away. At the end of February he entered the main pack, intending to push southward and westward, but after proceeding ninety miles was beset. For thirteen months the *Belgica* drifted in a more or less westerly direction, when, on the 14th of March 1899, she was eventually liberated.

The shores of Belgica Strait are formed of high mountainous land with steep slopes and narrow valleys. One peak appeared to be nearly 7000 feet high. The country is formed entirely of ancient crystalline rocks, *e.g.*, granites, diorites, and syenites. Gneiss only exists at the Pacific end of the Strait. All the interior is clothed with a mantle of ice, comparable to the "inland ice" of Greenland. The hillsides are glaciated, and the valleys are filled with glaciers which run into the sea. These do not calve table-topped icebergs, but break off into small irregular pieces, scarcely worthy of the name of icebergs. A line of soundings was taken from Staten to Smith Island. The greatest depth, viz., 2210 fathoms, was obtained close to Staten Island, and soundings of over 2000 fathoms were obtained not far to the north of Smith Island. Arctowski points out that the soundings in the pack seem to indicate that the isobath of 300 fathoms is the edge of the continental shelf and not the 100-fathom line. He further suggests that the continental shelf of Antarctic has been submerged. The terrigenous deposits contain besides grey mud a large proportion of sand, gravel, and a great number of rounded sea-worn pebbles.

The magnetical observations for dip, declination, and intensity have been taken. The perpetual movement of the pack did not allow of apparatus being installed for the determination of the variation. General astronomical observations were taken, and pendulum observations were made in the Straits of Magellan, at Puntas Arenas. Twelve principal stations in Belgica Strait have been determined astronomically, upon which the survey has been based.

July was the coldest month; its mean temperature was $-10{\cdot}3°$ F. The minimum temperature was $-45{\cdot}6°$ F., which was recorded in September. February was the warmest month, viz., $30{\cdot}2°$ F. The black bulb rose to a maximum of $113{\cdot}2°$ F. "The sky was usually overcast, most frequently with a thick layer of stratus, which formed a uniform grey covering, and often persisted for days or even weeks together, with only short breaks." The air was highly saturated the whole time. The lowest barometer

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reading was 28·022 inches, and the highest 30·400 inches, a range of 2·378 inches. There was a smaller variation during summer and winter than for the equinoctial months. There is high pressure at the solstices and low pressure at the equinoxes. The wind blew with almost equal frequency from northerly and southerly directions, and the easterly wind predominates over the westerly. "The directions of greatest frequency were west, east, and north-east."

A grass, some mosses, and lichens were the plants taken. There is a dipterous insect with rudimentary wings; podurids are found among the mosses and lichens. Among the fresh-water algæ were nematodes, rotifers, tardigrada, infusoria, and rhizopods. All these animals are the first examples known of the fauna of Antarctica. Penguins and petrels and the chionis were very plentiful, as well as seals, such as the sea-leopard, Weddell's sea-leopard, and the white Antarctic seal. The cetaceans were the humpback, and blue or fin-back whales. The plankton, though very plentiful, does not appear to be very varied. Stalked crinoids, asteroids, gorgonids, polychaets, pantopoda, ascidians were among the animals dredged. The medical officer's report promises to be of interest.

W. S. B.

THE INTERNATIONAL CONFERENCE FOR MARINE RESEARCH, STOCKHOLM, 1899.

THIS Conference, which was held in Stockholm in June of last year, was attended by the following Delegates: Messrs. Archer, Cleve, Drechsel, Ekman, Von Grimm, Heincke, Hensen, Herwig, Hjort, Hoek, Knudsen, Krümmel, Lehmkuhl, Lundberg, Sir John Murray, Nansen, Petersen, Pettersson, D'Arcy Thompson, Trybom, Åkerman.

The following resolutions were unanimously passed:—

Considering that a rational exploitation of the sea should rest as far as possible on scientific inquiry, and considering that international co-operation is the best way of arriving at satisfactory results in this direction, especially if in the execution of the investigations it be kept constantly in view that their primary object is to promote and improve the fisheries through international agreements, this International Conference resolves to recommend to the States concerned the followirg scheme of investigations which should be carried out for a period of at least five years.

PROGRAMME FOR THE HYDROGRAPHICAL AND BIOLOGICAL WORK IN THE NORTHERN PARTS OF THE ATLANTIC OCEAN, THE NORTH SEA, THE BALTIC, AND ADJOINING SEAS.

A.

The Hydrographical Work.

I.

The hydrographical researches shall have for their object: the distinction of the different water-strata, according to their geographical distribution, their depths, their temperature, salinity, gas-contents, plankton and currents, in order

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to find the fundamental principles, not only for the determination of the external conditions of the useful marine animals, but also for weather-forecasts for extended periods in the interests of agriculture.

II.

As the hydrographical conditions are subject to seasonal changes, and as these strongly influence the distribution and life-conditions of useful marine animals and the state of the weather and other general meteorological conditions, it is desirable that the observations should be made so far as possible simultaneously in the four typical months, February, May, August, and November, at definite points along the same determined lines.

III.

The observations referred to in II. would consist of:—

(*a*) Observations of temperature, humidity, and pressure of the air every two hours; self-registering instruments for interpolation, and Assmann's aspirator should be used.

Opportunities should be afforded to the meteorological offices to make on board the ships physical observations on the higher levels of the atmosphere by means of kites.

The other meteorological observations are to be carried out according to the methods adopted by the meteorological offices of the nations represented.

The observations, meteorological as well as hydrographical, made on board the special steamers at the time of the survey in the typical months, are to be immediately worked out under the supervision of the central bureau (see C) for publication in a Bulletin, wherein the conditions of the sea and the atmosphere are to be represented by tables and synoptical charts in co-operation with the meteorological institutes of the nations represented.

(*b*) The temperature of the surface-water shall be taken every two hours or, when necessary, more frequently. It is desirable that self-registering apparatus should be used for interpolation.

Observations on the vertical distribution of the temperature are to be taken at the points mentioned in II., and should be taken regularly at intervals of 0, 5, 10, 15, 20, 30, 40, 50, 75, 100, 150, 200, 250, 300, 400 metres and so on; but all *critical* parts of the curve must be determined by extra readings.

The bottom-temperature is to be investigated with all possible care.

(*c*) At every point and from every depth where the temperature is observed, a sample of water shall be collected for the determination of its salinity and density.

By *salinity* is to be understood the total weight in grammes of the solid matter dissolved in 1000 grammes of water.

By *density* is to be understood the weight in grammes[1] of 1 cubic centimeter of water of the temperature *in situ* $t°$, *i.e.* the specific gravity *in situ* referred to pure water of $+4°$ C $\left(= S^{t°}_{4°}\right)$.

For orientation, preliminary determination of the salinity should be made on board ship with expedient instruments, but the exact determination of the salinity and density of all samples shall take place in a laboratory for scientific work.

(*d*) At certain depths of the points mentioned in II., and elsewhere on the

[1] Units of weight are here used instead of mass-units.

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surface, water samples should be collected for analysis of the gas-constituents (oxygen, nitrogen, and carbonic acid).

IV.

For measurement of depth the *unit* to be adopted is the metre, together with which the depth may be also recorded in English fathoms.

Geographical points are to be referred to the longitude of Greenwich, and horizontal distances are to be expressed in sea-miles (=1852 metres).

Thermometers to be used for the determination of the surface-temperature may be either Centigrade or Fahrenheit, but for publication all numbers are to be reduced to Centigrade.

In the Centigrade thermometers the distance between two degree-marks should be at least 5 mm. and the degree divided at least in 2 parts, the Fahrenheit thermometer to be divided in a corresponding manner.

The use of Pettersson's insulated water-bottle is recommended for moderate depths, and the thermometers used for this apparatus should have a space of at least 10 mm. between the marks of one degree, and the degree should be divided in 10 parts.

For greater depths of the ocean Negretti-Zambra's or other thermometers of a similar type should be used.

The glass to be used for the thermometers, as well as the thermometers, should be tested and approved by the central bureau. (See C, *a*.)

For the determination of salinity and density, either chemical or physical methods may be adopted, provided that the salinity can be determined with an accuracy of 0,05 in a thousand parts (and the density up to 0,00004).

The determination of these constants can be founded either upon chemical analysis of the halogen by weighing or titration, or upon physical determination of the specific gravity by means of hydrostatical balance pycnometers and hydrometers, provided that measures be taken to exclude disturbances arising from thermal effects, capillarity, viscosity, etc.

The chemical analysis shall be controlled by physical methods, and the physical determinations by chemical analysis in the following manner:—

From every collection of samples examined at least three shall be selected and sent to the central bureau. *Standard samples* shall be sent in return.[1]

The *specific gravity* is to be represented in the tables by the formula $S\left(\frac{0^\circ}{4^\circ}\right)$.

V.

Samples for gas analysis are to be collected each time in a pair of sterilised vacuum tubes.

It is desirable that the existing tables of absorption of nitrogen and oxygen should be revised.

VI.

Qualitative plankton observations should be made every six hours by pumping through a silk net for the space of fifteen minutes, and at the same time a sample of water (III. *c*.) should be taken.

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[1] By *standard* water shall be understood samples of filtered sea-water, the physical and chemical properties of which are known with all possible accuracy by analysis, and statements of which are sent to the different laboratories, together with samples. In respect to halogen the ordinary water-samples have to be compared with the standard-water by analytical methods.

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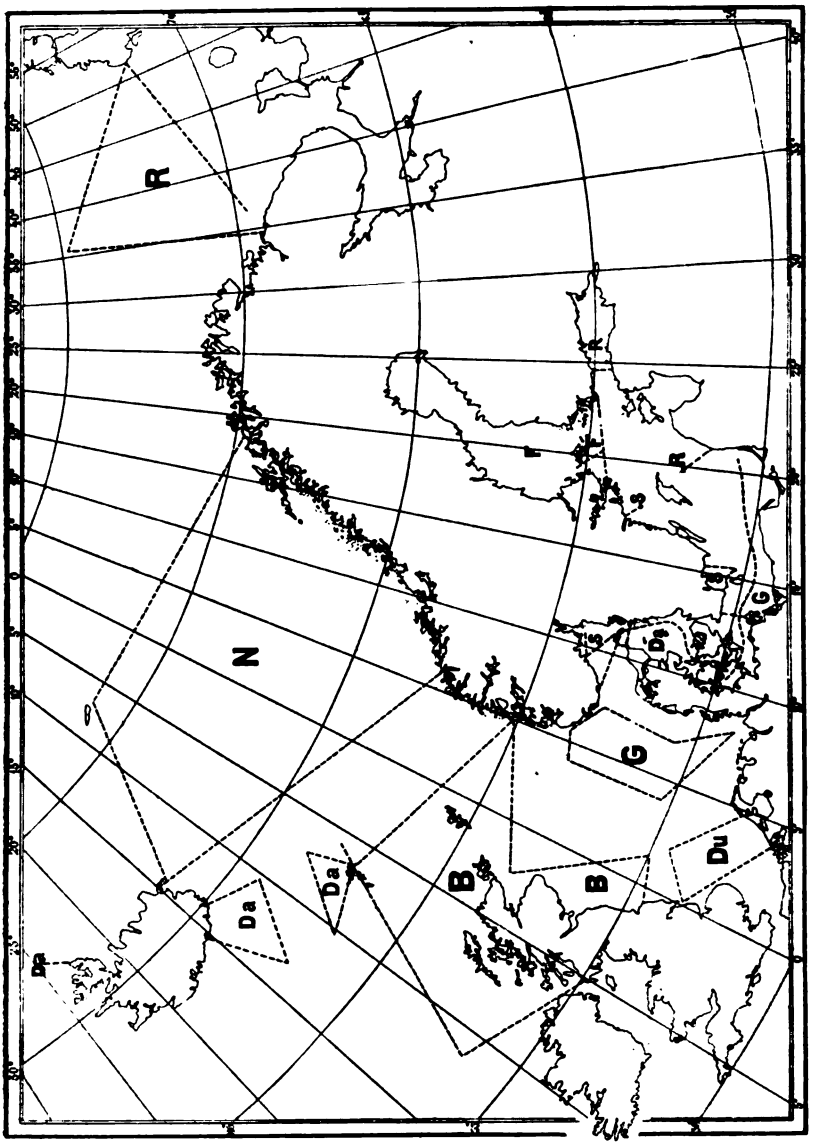
At the points mentioned in II. samples for quantitative analysis are to be collected according to the method of Professor Hensen at different depths, depending on the hydrographical circumstances.

Petersen's modification of Hensen's net is recommended.



PROVISIONAL CHART SHOWING WATERS ALLOTTED TO EACH NATION.

Observations on transparency and colour of the water should be made at the points mentioned in II.

Opportunities should be afforded to bacteriological institutions to carry out investigations in the ocean.

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VII.

Observations on currents and tides should be carried out as frequently as the circumstances allow.

The currents should be examined, when possible, by direct current-meters and by surface and intermediate floats and by bottom-rollers.

The ship should be anchored occasionally in order to make frequent observations during a complete period of tide.

VIII.

It is desirable that a chart should be prepared of the bottom of the seas examined, showing the nature of the sea-bottom.

The description of the deposits is to be carried out on a definite plan, to be afterwards settled.

IX.

The normal observations are to be carried out along the lines provisionally drawn on the annexed chart, where *R* denotes the Russian, *F* the Finnish, *S* the Swedish, *G* the German, *Da* the Danish, *Du* the Dutch, *N* the Norwegian, and *B* the British lines.

The special points are to be decided by the respective nations, and when once chosen, the subsequent observations are to be repeated at the same points.

The particular instructions for the stations will be given by the respective nations, and the communications as to the extent and the nature of the observations shall take place through the central bureau. (See C, *a* and *e*.)

X.

It is desirable, in carrying out these investigations, to make use of regular liners, light-ships, etc., and coast-stations for the purpose of taking temperature-observations and collecting samples of sea-water and plankton.

These observations are to be taken not only in the typical months, but also during the intervening periods.

B.

The Biological Work.

I.

(*a*) Determination of the topographical and bathymetrical distribution of eggs and larvæ of marine economic fishes. For example by quantitative methods, such as those of Hensen, and with special reference to the most important species, such as plaice, cod and haddock, herring, etc.

(*b*) Continued investigation of the life-history and conditions of life of young fishes of economic species in their post-larval stages and till they reach maturity with special reference to their local distribution.

(*c*) Systematic observation of mature marketable fishes with reference to their local varieties and migrations, their conditions of life, nourishment (as for instance by investigation of the contents of the stomach) and natural enemies: also observations on the occurrence and nature of fish food at the bottom, the surface and intermediate waters down to depths of at least 600 metres.

(*d*) Determination of periodic variations in the occurrence, abundance, and average size of economic fishes, and the causes of the same.

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II.

(*a*) Experimental fishings *on* the known fishing-grounds during the time of the fishery, as well as *outside* these areas and seasons.

(*b*) Preparation of uniform statistics of the experimental catches, with particulars of the number, species, size, weight, and condition of the fish: for example as done on board the *Garland* by the Scottish Fishery Board.

(*c*) The uniform use of appropriate apparatus for the experimental capture of the different species and sizes of fish.

(*d*) The experimental marking and liberation of fish, for instance of plaice, on as large a scale as possible and over extensive areas: for example as carried out by Dr. C. G. Joh. Petersen and Dr. T. W. Fulton (Reports of the Danish Biological Station, and the Fishery Board for Scotland), and others.

III.

(*a*) It is desirable to collect uniform statistics of the number, weight, and value of the fish landed, of the means of capture, and of the persons engaged in the industry: for example as in the General Reports of the Scottish Fishery Board.

(*b*) It is desirable to collect material for the preparation of maps, showing the fishing-grounds and the kinds of fishing there practised. (Cf. A. VIII.)

C.

Organisation of a Central Bureau.

I.

The Conference recommends that there should be for the international hydrographical and biological researches of the seas an international council with a central bureau, furnished with a laboratory. The central bureau will be

(*a*) to give uniform directions for the hydrographical and biological researches in accordance with the resolutions drawn up in the programme of the present Conference, or in accordance with such modifications as may be introduced later with the consent of the States represented,

(*b*) to control the apparatus and to ensure uniformity of methods,

(*c*) to undertake such particular work as may be intrusted to it by the participating Governments,

(*d*) to publish periodical reports and papers which may prove useful in carrying out the co-operative work,

(*e*) to decide the graphic representations, scales, signs, and colours to be used in the charts for the purpose of obtaining uniformity in the publications,

(*f*) to make in connection with the investigations application to the telegraph administrations for the purpose of obtaining determinations from time to time of the changes in the resistance of the cables which cross the areas in any direction.

II.

(*a*) The permanent international Council should consist of Commissioners elected by the governments interested. Each Government may appoint two Commissioners who may be represented at meetings by substitutes.

(*b*) The council elects its president and vice-president, and appoints all officials connected with the central bureau. Should the general secretary represent hydro-

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graphical sciences, his principal assistant should represent the biological sciences, or *vice versâ*.

(*c*) The council shall draw up its own order of proceedings.

(*d*) The expenses of the central office are approximately estimated at £4800 (96,000 marks) yearly.

(*e*) The place of the central bureau, to be decided by the Governments concerned, shall at the same time be the residence of the general secretary, and should be conveniently situated for hydrographical and biological researches.

(*f*) It will be for the Governments concerned to decide among themselves the share to be borne by each.

SCHEME FOR THE EXPENDITURE OF THE CENTRAL BUREAU.

1. General secretary,	£750
2. Principal assistant,	500
3. President, for incidental expenses other than travelling expenses,	200
4. Vice-president, for incidental expenses other than travelling expenses,	100
5. Office, laboratory, scientific and technical assistants, draughtsmen, clerks, servants, postage, telegrams, and similar expenses,	2250
6. Travelling expenses,	300
Note.—Travelling expenses of Commissioners attending meetings of the council shall be borne by their respective Governments.	
7. Printing,	500
8. Incidental expenses,	200
	£4800

D.

It is desirable that these investigations should begin May 1st, 1901.

E.

The Conference declares that it is of the greatest importance both for high-sea fisheries and for the weather-forecasts for long periods, that the Färoe Islands and Iceland should be included in the European telegraph system as soon as possible.

F.

The relation between the quantity of halogen contained in the water and the density of the water shall be carefully investigated by an experimental revision of the tables compiled by Knudsen (Ingolf Exp. II. 37). The tables compiled by Makaroff, Krümmel, and others for the relation of specific gravity to density and salinity are likewise in urgent need of experimental revision.

It is proposed to undertake these investigations in the technical institute at Copenhagen, under the direction of a committee, consisting of Messrs. Sir John Murray, Knudsen, Pettersson, Nansen, Krümmel, H. N. Dickson, and Makaroff. The means for carrying out this work are to be requested from such learned societies as have funds for such purposes.[1]

[1] With regard to the above resolution, the British Association has voted a grant of £100 for this work, and a similar amount has been granted by the Russian Government. Applications have been made in Germany, Denmark, Sweden, and Norway to learned societies, etc., for grants for the same purpose. Dr. M. Knudsen of Copenhagen, who was appointed by the Conference leader of this revisional work, is now ready to undertake the experimental part of the work in the laboratory of the Polytechnic Institute of Copenhagen.—O. P.

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G.

The Conference recommends that these resolutions be brought by the nations concerned to the knowledge of the Governments of France and Belgium.

H.

In case the resolutions of the Conference should be accepted by the States, it is anticipated that some length of time will elapse before the organisation of the central bureau is completed. In the meantime the Governments may wish to possess an organisation in connection with this Conference which may be useful in constituting the council and the central bureau.

The members of the third Committee, Åkerman, Drechsel, Von Grimm, Herwig, Hoek, Sir J. Murray, Nansen, and Pettersson, hereby offer their services for this purpose.

Stockholm, June 23rd, 1899.

(Signed) A. R. AKERMAN, *President.*
O. PETTERSSON, *General Secretary.*

RESOLUTION PASSED BY THE SEVENTH INTERNATIONAL GEOGRAPHICAL CONGRESS AT BERLIN, 1899.

The following Resolution was passed in support of the Stockholm Conference:—

Der VII. Internationale Geographische Kongress erklärt die Beschlüsse der Stockholmer Konferenz zur Erforschung der Meere vom Juni 1899, für so wichtig auch für die Förderung der Ozeanographie im Allgemein, dass er auch seinerseits den betheiligten Regierungen dringend die Durchführung der Beschlüsse in ihremvollen Umfang empfiehlt.

MEASURES TAKEN BY THE SWEDISH GOVERNMENT TO REALISE THE AIMS OF THE CONFERENCE.

Professor O. Pettersson, who acted as General Secretary to the Conference, writes that the Swedish Government, towards the end of last year, communicated with the Governments of the other North Sea Powers and of Russia, stating that the Swedish Government accepted the resolutions of the Stockholm Conference, and in case of agreement on the part of the other Governments interested resolved to ask from the Riksdag now assembled the funds necessary for the execution of the Swedish part of the international work. The communication also requested a statement of the position which the other Governments would take to the programme elaborated by the Conference, and especially with regard to the preliminary measures of organisation suggested at the close of the Resolutions.

Professor Pettersson informs us that the official replies to this note have not yet been published, but that special committees have been nominated in Denmark, Norway, and Germany in order to prepare the questions and to estimate the cost of participation by these countries.

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The Swedish Government has requested the Hydrographic Commission to elaborate a detailed programme and to calculate the expenses of the Swedish portion of the work. This programme, which is still provisional, is communicated to us by Professor Pettersson and is published below. It will be observed that the Swedish Hydrographic Commission has considered it unnecessary to enter upon details regarding the meteorological and hydrographic part of the investigation, for the reason that the Resolutions of the Conference, as will be seen above, are very explicit upon these points; the Commission has therefore concentrated its attention upon the biological and practical aspects of the research.

THE SWEDISH HYDROGRAPHIC COMMISSION'S REPORT TO THE GOVERNMENT

REGARDING THE ORGANISATION AND COSTS OF SWEDEN'S PART IN THE INTERNATIONAL CO-OPERATIVE INVESTIGATION OF THE NORTHERN SEAS.

By Professor O. PETTERSSON.

AT the request of the Government the Swedish Hydrographic Commission has worked out a scheme and calculated the costs for the organisation of that part of the international survey of the North Sea and Baltic, which, according to the resolution of the Conference at Stockholm, should be investigated by Swedish specialists. The chief contents are as follows.

The Swedish area of investigation consists of two parts—

1. Skagerack.

2. The western side of the Baltic from Stockholm to the isle of Bornholm.

As the international research concerns the open seas, not inshore waters, fiords, and estuaries, the first essential requirement is to have sea-going, well-equipped steamers. It will be for each Government to determine the number and size of the steamers to be used in the co-operative work. The Norwegian Government has ordered a steamer to be built for researches of this kind; in Denmark a steamship has been adapted expressly for the investigation of Kattegat and the Danish fiords and sounds. Russia has already built an excellent steamer, *Andrei Pervoswanny*, fitted out for scientific and practical research of the Barentz Sea. The Swedish Hydrographic Commission recommends the building of a new cruiser for the west coast of Sweden (Skagerack), the survey of the Baltic area to be executed by means of pilot ships and naval cruisers.

1. SKAGERACK.

The Commission proposes that the investigation in this part of the sea shall be conducted as follows:—

At the commencement of the months February, May, August, and November a complete hydrographic and biologic survey shall be made in

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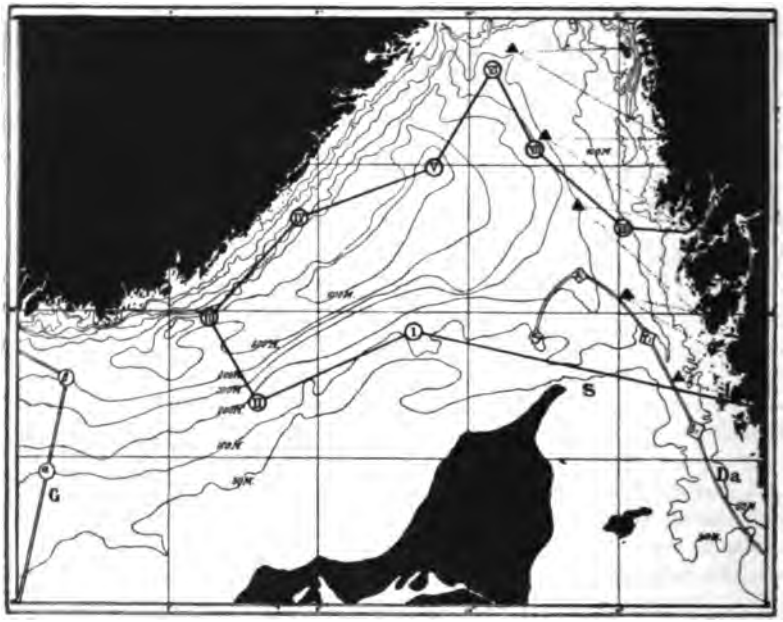
Skagerack with deep soundings at the points marked out on the annexed map (Stations I.-VII.) according to the programme of the Conference (see Resolutions A and B). The ship is to start from Gothenburg in such time that it can work at Stations I. and II. simultaneously with the German cruiser at *a* and the Danish steamer at *a*. At all these points,



THE SKAGERACK.

S. = Swedish Lines.
G. = German Lines.
◊ = Danish Stations.
▲ = Swedish Fishing Stations.
Da. = Danish Lines.
○ = Swedish Hydrographic Stations.
⊙ = German Stations.

which are situated on the south and south-west side of the deep channel of Skagerack, fishery experiments (trawling, etc.) are to be executed according to a common plan, the details of which must be settled by agreement between the different specialists and approved by the Central Council.

At Station V. in the central part of Skagerack trawling and dredging is executed at 650 metres depth only when circumstances are favourable. At the Stations III. and IV. only hydrographic and biologic work concerning plankton, fish eggs, larvæ, etc., is done, the conditions there being unfavourable for trawling, etc. Occasionally, at the mackerel and herring season, fishing experiments with drift-nets can be made. Immediately after the close of the regular hydrographic and biologic research the cruiser undertakes a minute examination of the fish-life on the east and north side of Skagerack. The dotted lines on the chart show the daily track and the fishing-stations of the steamer.

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During one or two weeks fishing experiments are made daily by means of trawls and great vertical nets on the outer coast-bank in extra-territorial waters, and by means of trawls and the plaice-seine on the inner coast-bank. In the afternoon the cruiser visits some harbour where a fishing-boat with full equipment of drifting-nets, lines, etc., is taken in tow to the next fishing-station. Here the fishermen set their nets and lines while the steamer uses the trawl and other fishing-gear during the night. Early in the morning the catch is brought on board the ship for counting and measurement. Such fish as are not reserved for further research are brought on board the fishing-boat, which immediately makes sail for the nearest port, where the catch is sold. The cruiser continues its trawling experiments during the forenoon. In the afternoon the plaice-seine is used, and the flat-fish caught are measured, marked, and immediately set free, whereupon the ship calls at another harbour where a new fishing-boat is waiting ready for the next night's fishing. In this manner the eastern and northern side of Skagerack is thoroughly investigated four times a year. In every place where fishing experiments are made the hydrographic constants, temperature, salinity, etc., are ascertained, and plankton, fish eggs, etc., collected by means of tow-nets from different depths. The scientific staff on board consists of an assistant for physical and chemical research, one or two biologists belonging to the Fishery Board of Sweden, and a fishing-master.

After the close of each series of such fishing experiments the cruiser anchors at the marine station, where the cargo of scientific apparatus, as well as fishing-gear, and that part of the catch which has been kept alive in tanks or preserved on board, is unloaded. The assistants make up the protocols and reports regarding the observations, and take care of the collections of animals, plankton, and water samples, etc., which are to be sent away to different specialists, laboratories, museums, etc. The leader and the first assistant prepare the tables and reports to be delivered to the Central Bureau.

2. The Baltic.

The hydrographic conditions of the Baltic are far less variable than those of the North Sea, and are on the whole better known. The reverse holds good with regard to biology. A number of new and important problems arise regarding the animal life in the deep waters of the Baltic, where the undercurrent brings in salt and relatively warm water, which has a temperature of + 4 to + 6° C. even in the coldest season of the year, when the upper water layers are cooled to about + 1° C. We know at present absolutely nothing of the development of animal life in the abysmal regions of the Baltic during the greater part of the year, although we can trace its influence from the diminution of oxygen and increase of carbonic acid in the amount of gaseous matter dissolved in the waters. It is probable that a close inspection will reveal to us most important facts with regard to the biology of the food fish of the Baltic, *e.g.* the salmon, the eel, the flat-fish, and others. The practical problems regarding fishery matters are also of a different kind in the Baltic since

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the effects of trawling need not to be taken into consideration in this part of the sea.

From these facts we may conclude that the same rules will not hold

THE BALTIC.

S. = Swedish Lines. F. = Finnish Lines.
R. = Russian Lines. G. = German Lines.

indiscriminately with regard to the investigation of the Baltic and the North Sea. The Swedish scientists think it not unlikely that an altogether different plan of investigation must be adopted for the Baltic

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than for the North Sea. In order to obtain reliable ground for further research they recommend first to make two reconnoitring researches, one in the summer (September) of 1901 and one in the following winter (March) 1902. On these occasions only a very limited number of places, which are indicated on the chart, should be examined, but the investigation should be as complete as possible both with regard to the scientific and the practical work.

Organisation.

The Swedish investigations should be directed by a special commission consisting of a president, the leader of the work, and three or five other members. The duties of the leader and members of the commission should as hitherto be performed gratuitously. Only travelling expenses, etc., should be paid according to the usual tax for public commissions.

It has been a leading principle of the Swedish hydrographers to separate as much as possible the analytic work from the work on board the ship. The samples of water, plankton, etc., collected on board are sent to different laboratories in Stockholm, Upsala, and other places, there to be examined by trained specialists.

For the fishery experiments it is however necessary to have a marine station where not only the fishing-gear can be unloaded and repaired, but also certain organisms, eggs, larvæ, etc., can be kept alive for a while and studied under appropriate conditions with regard to temperature, salinity, and pressure. For this purpose the place must be chosen so that the organisms in question can be kept alive in great tanks or aquaria in the open sea at that depth where the conditions are most favourable. There are very few marine stations in Europe where this condition is realised. The biologists who direct all our marine stations usually take no regard to the hydrographic conditions of the place. Consequently, we as a rule find their marine stations situated either in shallow bays or on promontories or islands freely exposed to wind and weather, surrounded by shallow water, rich in sand, or lime, or clay, which is incessantly whirled up from the bottom by the breakers. The Swedish scientists propose to establish a station, at very moderate cost, in a sheltered position on some rock rising perpendicularly from the bottom of one of the deep Skandinavian fiords. The fish and other organisms to be studied can be kept alive in great cages suspended from the top of the rock at convenient depths to 50 metres or more. As the salinity and temperature of the waters of such fiords varies considerably with the depth, it is easy to choose the level where the *optimum* with regard to physical and chemical conditions is to be found in each particular case. The undercurrent of pure salt water, cold in summer and warm in winter, brings an incessant supply of plankton and oxygen, provided that the depth does not exceed that of the threshold of the fiord.[1]

[1] In this manner young oysters from Arcachon in France, which inevitably die if exposed to the winter temperature of the upper layers of Skagerack, have been kept alive four winters, and attained the size of full-grown oysters, at Holma in the Gullmarfiord.

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The station shall also contain store-rooms for the fishing-gear and apparatus rooms for one assistant and for the fishing-master. The cost for the outfitting of such a station with the necessary apparatus is estimated at £1400.

The assistants will be instructed to make up lists of scientifically valuable objects of geological, zoological, and botanical interest, which are collected during the expeditions, for distribution among the institutions and universities of the participating countries that wish to complete their collections. This will contribute to make the northern part of the Atlantic and tributaries completely known from a geological and biological point of view.

The annual expenses are calculated as follows :—

1. Salary for a secretary to the leader,	£ 66
2. First assistant,	200
3. Fishing-master,	106
4. Biological assistants,	110
5. Expenses for marking of fish,	42
6. Expenses for chemical analytic work,	100
7. Expenses for biological analytic work,	84
8. Drawing, printing, etc.,	142
9. Extra expenses,	150
	£1000

To this add the contribution for Sweden's part to the Central Bureau calculated after the rate of the German proposal, . . £125
and for the central laboratory, ... 140

This calculation does not include the cost of the ship nor expenses for coals, etc.

If the total expenses for Sweden's participation in the international co-operation are calculated the result is the following :—

1. Building of the ship and outfitting of the station with apparatus, fishing-gear, etc. Once for all, ... £16,666
2. Annual costs for coals, wages, etc., . . . 3175

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meeting of Council.

At a meeting of Council held on 26th April, the undermentioned gentlemen were elected Members of the Society, viz. :—

Henry Coates, F.R.S.E.
Rev. Charles M'Ghee.
Robert Smith, B.Sc.

Before proceeding to business, the Chairman, Sir John Murray, President of the Society, expressed the regret of the Council at the death of Sir William Renny Watson, who was Chairman of the Glasgow Branch from its foundation in 1885.

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A resolution was passed expressing the Council's sense of the great loss sustained by the country and by the Society through the death of the Duke of Argyll.

Meetings held in April.

On the 26th April Mr. Nelson Annandale addressed the Society in Edinburgh on his recent travels in the Siamese Malay States. Sir John Murray presided. Mr. Annandale delivered a lecture on the same subject to the Glasgow Branch on the following evening.

Meetings fixed for May.

Mr. Robert Smith, B.Sc., Assistant-Professor of Botany, University College, Dundee, will, on 10th May, in Edinburgh, exhibit and explain the map of his Botanical Survey of Scotland.

On 23rd May, also in Edinburgh, Mr. Arthur H. Sharp, and, it is hoped, Mr. E. S. Grogan, will read papers on their journey from the Cape to Cairo, by way of Uganda, Tanganyika, and the Nile Valley. The President of the Society is expected to take the Chair on both these occasions. These will be the last ordinary meetings of the Session.

GEOGRAPHICAL NOTES.

EUROPE.

Proposed French Ship Canal.—The scheme for connecting the Atlantic Ocean with the Mediterranean by means of a canal 280 miles in length is being strongly advocated in France, and is now under the consideration of the Naval Committee of the Chamber. The canal, which would be important from the strategic point of view, would pass from Bassin d'Arcachon through Marmande, Agen, Castelsarrasin, Toulouse, Carcassonne, and Narbonne to the Étang de Sijean, and would have a branch to Bordeaux. Its highest point would be 655 feet above sea-level, and from 18 to 22 locks would be necessary to reach this height. The cost is estimated at about 32 millions sterling, and the annual profit on its working at about £900,000. It is believed that the work could be completed within five years. The water route from the north-west of France to Malta would be shortened by 1090 miles.—*National Geographic Magazine*, March 1900.

The Macedonian Lakes have been studied by Professor Jovan Cvijić, who is now preparing a geological map and a geomorphological description of that country. Lake Ochrida is one of the deepest in Europe, standing tenth in this respect, at a depth of 938 feet; it is fed by many springs, and its water is very clear and of a pure blue. Lake Presba (or Prespa) is 177 feet deep, and Lake Ostrovo 200 feet. Professor Cvijić is making bathymetrical maps (1 : 100,000) and profiles of the lakes. The most rapid decrease in temperature in a downward direction occurs at an unusual depth in all these lakes, being in some cases nearly 82 feet below the surface.—*Geographical Journal*, 1900, p. 417.

ASIA.

Teheran and its Neighbourhood.—Herr A. F. Stahl publishes an account of the geology, climate, flora, fauna, and inhabitants of this district, together with a description of the town itself and of the communications and villages in the neighbourhood. There is also a map of the district (1 : 210,000). The town lies

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on a loess plain which sinks gently southward; it is flanked on the north and east by high mountains. In summer the surrounding country is very dry, but during the rest of the year rain and snow are plentiful, the latter remaining on the hills throughout the winter, and even, on the highest mountains, sometimes throughout the year. The barometric mean is 660·3 mm., the lowest in July and August 653 mm., the highest from October to January 673 mm. The absolute minimum of temperature was −14° C., and the maximum was 42° C., in shade. The climate is generally healthy, epidemics being traceable to dirt; there are, however, endemic fevers in the low-lying and damp parts in summer. A curious feature of an otherwise rich fauna is the small number of species of fishes. The population of the city is estimated at 250,000; that of the city and surrounding villages at 600,000. The former is very mixed: Turks, Armenians, Chaldeans, Jews, Kurds, Arabs, Persians, Negroes, Mulattoes, and Europeans. The city has a mean appearance; there are only a few good streets in the northern part. Trade is in the hands of Armenians, British, Germans, and Austrians; the Russians are not represented.—*Petermanns Mitteilungen*, 1900, III.

The Region of the Lower Yrmak is described and mapped (1 : 250,000) by Lieutenants Maercker, Kannenberg, and Schaeffer from Angora to Sinope and Samsun on the Black Sea. (Von Prittwitz and von Flottwell, who are associated with the above officers in these researches, communicated their observations to *Petermanns Mitteilungen*, Ergänzungsheft 114, 1894.) The newly published papers, minutely describing the region of the above-mentioned river and of the Jeshil, give particulars of many kinds—geological, economic, anthropological, etc., are written in the form of itineraries, and show their military origin in the careful description of routes.—*Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1899, No. 5.

The Russian Tian Shan is further described by M. G. Saint-Yves, who published an account of the range known as Terskei Ala Tau, south of Issyk Kul, in the *Annales de Géographie* of May 1898. Since that date M. Saint-Yves has again visited these regions with Lieutenant Bourgoin, and has studied the Tian Shan mountains between the col of Tozor and that of Oulakol. He distinguishes various sections of this portion of the range, and describes the high pasturages, inhabited by many horse-breeding Kirghiz, the coniferous forests, the administration and inhabitants of Narynsk, and the strategic routes and Russo-Chinese frontier.—*Annales de Géographie*, March 1900.

Across Corea.—M. Marcel Monnier has given an account of a journey through this country in a paper which he intends to develop in the third part of the *Tour d'Asie*, "*L'Asie en diagonale, de Séoul à Bagdad.*" Corea is but little known, though its political importance, as well as its intrinsic interest, make it deserving of attention. Seoul, and Chemulpo its port, their inhabitants and customs; the journey from the Yellow Sea to the Sea of Japan across the province of Kang Wento and Keoum-Kan-Sann or Golden Mountains; and the port of Wön-San, are vividly described.—*La Géographie*, January 1900.

The French Military Map of Asia.—The "Service géographique" of the army has issued the first sheets of a map of Asia (1 : 1,000,000). The projection chosen is the polyhedric, and the initial meridian is that of Paris. The sheets are limited by meridians and parallels, and have the uniform height of four degrees of latitude; their width is six degrees of longitude from the equator to 52° N., and north of that latitude twelve degrees. Each sheet is designated by the numbers of the parallel and of the meridian which bound it on the north and east. Four colours

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are employed, differentiating the roads, water, mountains, and railways. Relief is indicated by shading as by an oblique light.—*Annales de Géographie*, March 1900.

AFRICA.

The Oasis of Wargla.—More than a thousand ancient artesian wells have been found in this group of oases, but of these 700 have become stopped. In 1883 the French began to sink new wells, 54 of which have proved successful, giving enough water for 50,000 date palms. The ground throughout the oasis is so saturated with water that the cultivation of cereals, fruit-trees, and vegetables is difficult. The population consists of about 4000 residents, who cultivate the palms; of about 6000 nomads, who carry on the trade over the desert; and many Jews, who have crushed the inhabitants by usury. There are 436,252 palms in the whole group. M. P. Blanchet opposes the scheme to continue the railway from Biskra to Wargla as incapable of giving any real life to the decaying oasis.—*Annales de Géographie*, March 1900.

The Trade of Africa in 1898.—Most of the trade belongs to the older extra-tropical European possessions, fully 70 per cent. of the total being divided between Cape Colony (42 millions), Natal (6·6 millions), Algeria (22·9 millions), and Egypt (22·8 millions). Next to these come Mauritius (5·8 millions), Portuguese East Africa (4·4 millions, including goods in transit), and Tunis (3·9 millions). Other countries, however, show a steady increase within recent years, though much of this is due to a greatly increased export of rubber, obtained too often by wasteful methods which must before long lead to a reduction in the supply. The British colonies continue to do a preponderating proportion of their trade with the mother country, but a falling off of British trade is recorded in several of the foreign possessions, *e.g.*, Madagascar (owing to the new tariff), Angola, and the Congo State. With many of the French West African colonies, however, it has shown a marked increase during the past few years, the total volume of British trade with these having more than doubled since 1894.—Further particulars are given in the *Geographical Journal*, April 1900.

The Dinkas, who inhabit the region south of the Bahr-el-Homr, are characterised by extreme length of limb and by a somewhat finer profile than that of neighbouring peoples; the nose is straight and the lips thick; the close hair is covered with red earth. They wear no clothes, but carry copper or iron bracelets armed with spikes, and an ivory bracelet over the biceps. They are without organised rule, but the richest inhabitant represents his village in discussions and treaties. They are believers in metempsychosis, and regard all misfortune as the work of sorcerers. Millet and maize are cultivated; sheep, cattle, and goats are reared. The elephant, giraffe, hippopotamus, hyena, lion, and ostrich are the chief wild animals.—*Revue Française de l'Etranger et des Colonies*, March 1900.

AMERICA.

Southern Patagonia.—Professor J. B. Hatcher of Princeton University, who has travelled for the last three years in that part of Patagonia which lies beyond the 46th parallel of south latitude, has recently described the geology of that region with a view to the study of its peculiar drainage systems. The eastern coast is lined throughout its whole length by bold cliffs which rise to a height of from 300 to 500 feet, and this line of bluffs is only interrupted at the mouths of the few rivers which flow across the plains from the Andes to the Atlantic. The rocks forming the cliffs consist of alternating layers of sandstones and clays, nearly

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horizontal, of a light brown or grey colour, and everywhere free from faults. Towards the north these strata belong to the Patagonian beds, of Middle Tertiary age and marine origin; these marine beds attain their greatest development at San Julian, where they are 900 feet thick. From this point they dip slowly to the south-east, the succeeding strata gradually disappearing beneath the sea as one travels southward. About 40 miles south of the Santa Cruz river a second series of rocks of lighter colour and softer materials appears overlying the Patagonian beds. These are the Santa Cruz beds, of lacustrine and æolian origin. These beds are, farther south, in their turn covered by the Cape Fairweather beds, which make their first appearance at that cape, and are of marine origin. Throughout the whole extent of this coast the uppermost crest of the bluffs is composed of from 20 to 30 feet of unstratified boulders and clays, constituting the great shingle formation of Patagonia, which covers the whole surface, and is probably of combined aqueous and ice origin. From the summits of these lofty escarpments a broad and elevated plain extends westward to the base of the Andes; its surface is thinly covered with soil, which supports a scanty grass. There are numerous great depressions, or rather excavations, scattered over the surface of the plain, frequently several miles in diameter, and from 100 to more than 1000 feet deep, containing in most cases small saline lakes at the bottom. These lakes are much diminished by evaporation in periods of drought, when thick beds of salt are deposited. "An examination of the depressions occupied by such lakes," says Professor Hatcher, "reveals the fact that the bluffs on one side are always much lower than those on the other sides, and, further, that the lower side always lies toward the present drainage system of the particular region in which the lake is situated. All this leads to the inference that these are residuary lakes, left as confined bodies of water at the final elevation of the land above sea-level, and, further, that the depressions are remnants of former drainage systems, existing prior to the last submergence, and corresponding approximately, though not entirely, with those of to-day." Other features described are the broad, deep, transverse valleys which cross Patagonia from west to east and form the chief drainage systems; the series of escarpments, often several hundred feet in height, that terminate a succession of terraces, encountered at varying elevations as one proceeds westward from the coast, or as one passes from north to south across any of the great transverse valleys; and the sheets of lava which in many places on the plains cover the sedimentary rocks, and present a broad level surface of huge expanse, covered with highly vesicular scoriæ, or a surface carved into a confusing labyrinth of deep and almost inaccessible cañons.—*National Geographic Magazine*, February 1900.

NEW BOOKS.

The Australian Handbook, 1900. With Maps and Plans. Pp. 672. London, Melbourne, etc.: Gordon and Gotch.

The Australian Handbook well sustains its reputation as the best reference-book for all general and statistical information regarding Australasia. The Descriptive Gazeteer and the Maps and Plans appear to have been carefully revised to date. From a geographical as well as commercial point of view the special articles and statistics showing development of agriculture, mining, colonisation, and shipping are of great interest.

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Ralph Fitch, England's Pioneer to India and Burma. By J. Horton Ryley, London: T. Fisher Unwin, 1899. *Price* 10*s.* 6*d.*

Probably the first Englishman who ever went to India was the Jesuit Stephens or Stevens, born at Burton in the diocese of Salisbury, who landed at Goa in October 1579. He remained there for many years, and eventually became rector of Salsette. He died at Goa in 1619. Ralph Fitch, however, may justly claim the honour of being England's first commercial pioneer to India and Burma, but of his personal history very little is known, not even the dates of his birth and death. He lived in the age of Queen Elizabeth, the dawn of commercial enterprise for England, and his share in opening up new avenues of commerce must be pronounced second to none in his day, even when we think of such brilliant adventurers as Drake, Hawkins, and Ralegh. Happily we have the story of his travels in his own words, and these have been given verbatim, with one unimportant exception, in the able and interesting volume we have now before us. The introduction to his narrative gives a concise summary of his travels, and may be quoted here. "The voyage of Mr. Ralph Fitch, marchant of London, by the way of Tripolis in Syria, to Ormus, and so to Goa in the East India, to Cambaia, and all the kingdome of Zelabdim Echebar the great Mogor, to the mighty riuer Ganges, and downe to Bengala, to Bacola and Chonderi, to Pegu, to Jamahay in the kindome of Siam, and backe to Pegu, and from thence to Malacca, Zeilan, Cochin and all the coast of the East India; begunne in the yeere of our Lord 1583 and ended 1591, wherein the strange rites, maners and customes of those people, and the exceeding rich trade and commodities of those countries are faithfully set down and diligently described, by the aforesaid Mr. Ralph Fitch." A perusal of his story gives us the impression that he must have been a man of no ordinary strength of character, cool and collected in danger, far-seeing, prompt and daring in action, never at a loss in a difficulty, of extraordinary personal courage, an acute judge of men of all ranks, courteous and conciliatory in his manners, and a shrewd hand at a bargain. In the course of this long and dangerous journey through lands where the foot of an Englishman had never trod, necessarily utterly ignorant of the language of the peoples whom he encountered, his urbanity, wisdom, and courage stood him in such good stead that only once did he fall into trouble. This was at Goa, where he and his companions were arrested as spies and thrown into prison. Here, as the Portuguese were intensely distrustful and jealous of the English, the party might have found an end to their enterprise and a grave, but for the good offices of the Jesuit Stephens, who induced the Viceroy to let them out of prison on bail. When their security began to blackmail them beyond what the sturdy Englishmen would stand, they applied for redress to the Viceroy with most unsatisfactory results. "Wherevpon we presently determined rather to seeke our liberties than to bee in danger for euer to be slaues in the country, for it was told us we should haue y^e^ strapado. Wherevpon presently the fift day of April 1585 in the morning we ranne from thence." Having made their escape with their goods and belongings, they struck up country to Agra, where was the court of "Zelabdim Echebar the great Mogor," who was, of course, none other than Jellaluddin Akbar the great Mogul, fortunately for them the most enlightened monarch who has ever lived in India, and eager to welcome strangers from any part of the world. In September 1585, the adventurous party broke up at Futtehpoor Sikri, the Windsor of Agra; Newberi proceeded to Lahore and Persia on his way home to England, which, however, he never reached; Leades remained in the service of Akbar, and never returned; while Fitch started alone for Pegu in Burma, *viâ* the Jamna and Ganges. On arriving at Serampoor on the Hughli, he took ship for Pegu "in a

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small ship or foist," of which he says, "if any contrary wind had come, we had thrown many of our things ouer-boord; for we were so pestered with people & goods that there was scant place to lie in." His description of Pegu, its king, priests, customs, merchandise, temples, etc., is in greater detail than usual and intensely interesting, and its accuracy has been proved by the observations of later travellers. From Pegu he sailed to Malacca, and on the 29th March 1588 began to retrace his steps homewards. The return journey *viâ* Ceylon, Goa, Ormus, Bapora, Babylon, Mosul, the Euphrates, Aleppo, and Tripolis took over three years, and he reached London just nineteen days after the start of the ill-fated Raymond expedition, which ended in utter disaster. His arrival must have inaugurated a new era for the merchants of England, for they had now among their number one who had personal knowledge of Eastern countries of which hitherto they had only had the more or less fabulous tales of the Portuguese and Spaniards; and there is ample evidence in the records of the East India Company and others to show that Fitch was consulted and regarded as a trustworthy authority on commercial expeditions to the East. He lived for a long time after his return in 1591, but, as we mentioned before, the date of his death is not known.

The story of Fitch takes up of course the principal part of this book, but there is much entertaining matter as well. We have an interesting and well-written compilation of what is known regarding his companions and some of the leading merchant princes of the time. And to this we have to add disquisitions on the historical and economic conditions which prevailed in England so far as they affected commercial enterprise. In these the author shows himself an earnest and careful student of his subject, who has formed decided opinions, which he expresses with lucidity and skill, but some of which will not be universally accepted. For example, his appreciation of the part played by Queen Elizabeth with regard to commercial enterprise is open, we think, to serious question, but we cannot enter upon such a discussion now. We congratulate the author on having produced a most interesting work, which is a valuable contribution to our materials for the study of what is in many respects the most interesting age of English history.

In Afric's Forest and Jungle, or Six Years among the Yorubans. By the Rev. R. H. Stone. Edinburgh and London: Oliphant, Anderson, and Ferrier, 1900. *Price* 3*s.* 6*d.*

In this little volume the writer describes his experiences as an American missionary "among the barbarous people inhabiting that part of Western Central Africa lying between the Bight of Benin and the Niger river, and between parallels five and seven, north latitude." Certainly his life in that unhappy country had no lack of excitement. His house was liable to invasions at night by "driver" or "soldier" ants, which when out on the hunt sometimes "cover an acre of ground or the inner walls of a large house," and "devour anything living that either cannot or will not flee from them." Worse than the "driver" was the large white ant, which devours everything except metal, stone, and the hardest wood. Mosquitoes, scorpions, and centipedes of various virulent types have to be added to the list of household pests, with an occasional visit from "ground pigs." Outside the house at night roamed leopards, hyenas, and tiger-cats, ready to make their way inside if they could find an open door or window. They had, however, their use as scavengers, for "the dead bodies of bankrupts, mendicants, and babes (!) in this country are not buried, but are thrown out into the bush along the town walls." With regard to the climate we read, "all white people who go to this part of Africa should expect to be sick. If they escape malarial fever they

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will meet chronic dysentery, and the last is worse than the first." Nor are these the only maladies to be dreaded, for smallpox, Guinea worm, boils, and ulcers were general.

The people, though brave, are mere savages, cruel, polygamous, sunk in superstition, worshipping devils, and fearing death as the introduction to greater misery than they now endure. The author had a narrow escape for his life from an angry mob, because he prevented a boy who pretended to be possessed of a devil from setting fire to a house. We may add that an accidental or involuntary breach of etiquette in the presence of the ruler is punished by death. While the author was in the town of Ejahyay, it was attacked by a neighbouring potentate, and the description of the battles round the town, the famine inside it, and his own and his wife's escape to Abeokuta is remarkably well written, and probably the best part of the book. Even at Abeokuta, however, there was no peace, for the town was in abject terror of an attack from the bloodthirsty king of Dahomey and his famous Amazons. It is not surprising to read that in a short time the missionary's wife's health broke down and they returned to America, soon after which the missions at Ejahyay and Abeokuta were broken up and transferred to Lagos. As the country has now passed into the hands of the British, missionary enterprise has been resumed under more hopeful auspices. Neither the country nor its inhabitants seem to have one redeeming feature, and we cannot but regard with admiration and respect the devotion and self-sacrifice of missionaries who, like Mr. Stone, risk health and life in the endeavour to christianise them.

Nigeria: Our Latest Protectorate. By CHARLES H. ROBINSON, M.A. London: Horace Marshall and Son, 1900. Pp. 223. *Price 5s. net.*

On 1st January 1900, a Proclamation in name of Queen Victoria was issued, translated into Hausa, and posted up throughout Nigeria, to the effect that "the Administration of the Protectorate of Northern Nigeria, hitherto known as the Niger Territories," was from that day "assumed by Her Majesty," and ceased to be vested in the Royal Niger Company. Thus twenty-five million souls were transferred to the British Crown, and Canon Robinson says that "apart from our possessions in India and Burma, there is no native state or combination of states within the limits of the British Empire which can compare in size, population, and importance with this our latest Protectorate."

By the Anglo-French Treaty of 15th June 1898, France definitely recognised as within the sphere of British influence "the whole of the territory occupied by the great Hausa-speaking race," and the author (who is Lecturer in Hausa in Cambridge University) adds that of the twenty-five millions now residing in the new British Protectorate of Nigeria, about fifteen millions speak the Hausa language. He has a high opinion of the Hausas, without whose aid as police and soldiers the work of the Royal Niger Company could not have been carried on. Although the Hausas are valiant in war they are naturally not soldiers but traders; they are extremely hospitable to strangers, "though their babies scream with horror at the sight of a white man"; and when placed in authority they are thoroughly trustworthy, for "a Hausa policeman is almost as incorruptible as an English judge."

In this well-illustrated volume we find, written by one of the highest authority, a description of the very valuable Protectorate which Britain has acquired; and whether as a commercial or a missionary field the author commends Nigeria to the best attention of his fellow-countrymen. A good map is given showing the boundaries of Nigeria, and of the territories of the other European powers.

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From Cape Town to Ladysmith. By G. W. STEEVENS. Edited by VERNON BLACKBURN. Edinburgh and London: William Blackwood and Sons, 1900. *Price 3s. 6d.*

There is a mournful interest attached to this volume, for it is the last that can appear from the hand of one who, although a young man, had justly won a high reputation in the literary world, and who was already a favourite of the public. The secret of his success was not the profundity or extent of his knowledge, but it lay in a bright, vivid, and picturesque style, requiring no unwonted attention or study on the part of his readers, and yet so clear and attractive that the scene portrayed seemed to pass before one's very eyes. This, of course, implies unusual powers of observation and description, the former to select and to proportion accurately what points are worthy of recording and depicting, the latter to clothe these observations in a literary and artistic form which shall be acceptable to the general reader. As an exponent of the impressionist style G. W. Steevens was second to none of the war correspondents of the day. This, his last work, consists of fifteen short chapters describing what he saw of the South African war, between the 10th October 1899 when he landed at Cape Town, and the 6th December when he was cooped up in Ladysmith. Early in January of the present year he succumbed to enteric fever. The best passages of the book are those which describe the battle of Elandslaagte, a bivouac, and the battle of Rietfontein. The last four chapters were written after the Federal army had closed round Ladysmith, and describe with remarkable power the routine and dulness of life inside the besieged town, where, as Steevens quaintly puts it, "you squirm between iron fingers. Nothing to do but endure." These chapters acquire a new interest from what has been disclosed regarding the wretched condition of the brave garrison and citizens since their relief. The conclusion of the book is an appreciation of Steevens by his friend Vernon Blackburn, who writes an eulogium, the effusive enthusiasm of which may well be pardoned under the circumstances.

La Géographie Militaire et les nouvelles Méthodes géographiques. La France du Nord-Est. By O. BARRÉ. Paris: Berger-Levrault et Cie., 1899. Pp. 122.

The first volume of this work dealt with the study of Central Europe; the volume now before us describes the geography of the Vosges, Alsace, Lorraine, the valley of the Saône, the eastern Parisian region, and the Morvan and primary plateaus. The work is well illustrated by numerous maps, geological sections, and perspectives. The book is both genuinely scientific in method, and very readable in style.

Field Testing for Gold and Silver a Practical Manual for Prospectors and Miners. By W. HAMILTON MERRITT, F.G.S. London: Crosby Lockwood and Son, 1900. Pp. viii + 144. *Price 5s. net.*

This little handbook, by a well-known authority on mining, supplies the prospector with all information for recognising the various ores and estimating the value of specimens by means of the simplest forms of testing apparatus. The main scientific principles involved in assaying are outlined in the section on Practical Mineralogy.

Paris. By AUGUSTUS J. C. HARE. Two vols. Second edition; revised. London: George Allen, 1900. Pp. 268 and 290. *Price 3s. each vol.*

This pleasant and scholarly guidebook can be recommended to those who wish to know Paris.

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE BASIN OF THE YUKON RIVER IN CANADA.

By J. B. TYRRELL, M.A., B.Sc., F.G.S.

(*Read at the Society's Hall, Edinburgh, January 8th; also in Dundee, January 9th, and Aberdeen, January 10th.*)

IN the extreme north-western part of the continent of America, as far removed as possible from the early settlements on the Atlantic sea-board, the mighty Yukon rolls for 2000 miles northward and then westward, between cloud-capped mountains and through extensive flowery plains, to discharge its waters into Behring Sea. For numberless ages it has flowed through this beautiful, but lonely and silent wilderness, unvisited by any save a few of the animals of the Pleistocene Period, among them the mammoth and the wide-browed bison, who wandered along its banks, and called to their fellows across its quiet pools; and when these had disappeared, by the shy moose, at present the giant of the Canadian forest, and the vigilant caribou. In pursuit of the latter, a few men, as wild as these wild animals themselves, were roaming here and there over the hills and valleys.

The country might have remained almost unknown for many years to come, until the tide of European civilisation, advancing from east and south, had flowed quietly and slowly over it, had not the discovery of rich gold mines caused a rush of population to that distant land, to form a centre of human activity and progress, from which civilisation may radiate in all directions.

SIZE AND POSITION.

The Yukon river rises within the Dominion of Canada, and for rather more than a third of its length flows through British territory, its lower

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reaches, for nearly two-thirds of its length, being within the United States territory of Alaska.

This evening my remarks will be confined to that portion of the Yukon basin which is entirely within the Dominion of Canada.[1]

It lies between W. long. 129° and 141°, and between N. lat. 59° and 64° 41′. It forms an irregular area with a greatest length, in a north-westerly and south-easterly direction, of 500 miles, a greatest width of 420 miles, and a total area of 123,500 square miles.[2]

It is thus slightly larger than Great Britain and Ireland, Austria, Hungary, or the province of Manitoba, and is almost exactly the size of Norway.

Valley of the Yukon river as seen from the hill behind Dawson. The Klondike river in the foreground.

Lying as it does between N. lat. 59° and 64° 41′, it occupies a somewhat similar position on the western side of America to that occupied by the central portion of Sweden on the western side of Europe.

Boundaries.

It is bounded on the south-west by the range of lofty, snow-capped mountains which reach from the coast of the Pacific Ocean inland for

[1] For the latest information about the adjacent territory of Alaska, I would refer to a brochure (with ten maps), recently published by the United States Geological Survey, entitled, *Maps and Descriptions of Routes of Exploration in Alaska in 1898.*

[2] To this should be added an area of 24,000 square miles in the basin of the Porcupine river, one of the northerly tributaries of the Yukon; but as the Porcupine basin is almost cut off from the basin of the Upper Yukon by a spur of the mountains from the east, and is connected closely with the basin of the Lower Yukon in Alaska, it will not be considered here.

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from 70 to 100 miles, and terminate towards the north-west in the St. Elias Alps, among which are the highest and greatest mountain peaks in North America. As the name St. Elias is of distinctly local significance, I have elsewhere proposed to apply the general name Chilcat mountains to this range, which rises steeply from the coast, and within a few miles forms a watershed between the short rapid streams that flow into the Pacific and the streams that flow northward across the great interior plateau to the Yukon river and finally empty into Behring Sea. These Chilcat mountains have a roughly serrated outline, with peaks rising from 8000 to 19,500 feet above the sea, while in many of the intervening valleys rest great glaciers, which in places join together and form vast fields of snow and ice. As I stood on the summit of Mount Malony, one of the highest peaks, rising on the bank of a branch of White river, and looked away southward towards the Pacific, I saw a vast field of snow stretched out before me, through which rose dark, massive, craggy summits, and as the clouds rolled along, and heaved, and fell, I got one short glimpse of St. Elias itself. Possibly we were the first white men to see this mountain from the landward side, and, at all events, whether we were or not, the sight of this extensive mountainous region, throwing out numberless glaciers both to the south and to the north, both towards the sea and away from it, was a most instructive one. It was so very suggestive of the conditions which had prevailed at an earlier time, when the Glacial Epoch held the region in its icy grasp, and when the fields of snow and ice were very much more extensive than they are at present.

From the crest of the Chilcat range the country descends to the interior table-land, which has been called by Mr. Brooks of the United States Geological Survey, the Yukon plateau.

To the east and north-east the Yukon basin is bounded by a range of high, rugged mountains, which is evidently a northern continuation of one of the ranges that farther south are grouped together under the rather indefinite name "Rocky mountains." Of this portion of the range very little is known. Last summer it was crossed in several places by a number of prospecting parties on their way from Edmonton, by the Mackenzie river, to the Klondike goldfields. From these parties some information as to the position of the mountains was obtained, but beyond the general statement that no gold could be found in them, little or nothing could be learned of their character. Unlike the Chilcat range near the coast, this range would seem to be quite free from glaciers, though from the higher elevations near Dawson snow can be seen on the highest peaks throughout the summer. The summits have probable elevations of between 5000 and 8000 feet above the sea.

Topography.

The Yukon plateau, lying between these two ranges of mountains, is not by any means a level plain, but is rather a widespreading area of rounded mountains with a general relief of from two to three thousand feet, the summits being roughly at the same general elevation. As seen from these summits, the country stretches away in numberless billowy hills, crest beyond crest, as far as the eye can reach, or until the view is

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cut off by the higher and more rugged peaks of the Chilcat or Rocky mountains. The hills, or knobs, have no kind of definite linear arrangement. They present the characteristics of having been moulded into their present shapes by atmospheric denudation and stream erosion from a pre-existing plain, though this plain itself, being underlain by rocks which have been much crumpled, and are of very different degrees of hardness, may have had an irregular surface. Remnants of this plain are seen on the tops of the hills and on the crests of the ridges at an average elevation of about 4000 feet above the sea, while some of the higher mountains, like Mount Malony on Nisling river, and the Dome at the head of Hunker creek, rise as higher points above it.

Valley of the Klondike river as seen from the hill behind Dawson.

As the Yukon plateau is thus a great, deeply eroded plain, it presents the characteristics of such a plain in marked degree: wide valleys traverse it from side to side or from end to end, deep lateral valleys join these main arteries, and harder and more resistant areas have formed central masses, from which valleys radiate in all directions to finally join the main arteries. One of these main valleys extends from the head of the Lynn canal, up the Chilcat river, across the summit of the Chilcat mountains at an approximate elevation of 2600 feet, down the Alsek river, up the Klukshu river to Klukshu lake, across a low plain to Dezedeash lake, down the Kaskawulch river to Aishihik river, up the Aishihik river, past Aishihik lake, across a swampy flat to Nisling river, down the Nisling river to White river, and down White river to the Yukon river. Perhaps it is a continuation of the same great valley in which the Yukon river flows just above Dawson, and which at Dawson continues eastward up what is now the valley of Klondike river. Below Dawson the Yukon flows in a narrower valley to the mouth of Forty-

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Mile river, and then that main valley continues up Forty-Mile river. In fact, I consider that the Yukon valley for fifty miles below Dawson is the lower part of the original Forty-Mile valley, which joined the Yukon-Klondike valley at Dawson. Many other large valleys doubtless traverse the country, but as yet they have not been traced out.

As the region would appear to have been unequally depressed and elevated since these great valleys were originally formed or outlined, the large streams do not necessarily follow them continuously, but, as I have shown to have been the case with the Yukon river near Dawson, they may cut out of one valley into another.

The direction in which the water flowed in these old valleys when they were formed, or rather when they were the main arteries for the drainage of the whole country, has as yet not been determined, but it would seem not improbable that it was generally towards the Pacific Ocean, and that the valleys are genetically connected with the deep fiords which indent the coast, the flow of water southward having been broken and stopped by the geologically late elevation of the Chilcat range of mountains, which gave the whole land a gentle slope towards the north. Further investigation will doubtless bring together much valuable information on this interesting subject.

Among the smaller areas, with radiating drainage, none are of more immediate interest or are better known than the Klondike gold-bearing district, in which the valleys diverge outwards in all directions from a high central point, which is known as the Dome, and finally open into the Klondike valley on the one side, or into the Yukon valley on the other.

The Yukon basin may be divided into two great divisions by a line which is more or less roughly parallel with the general trend of the Chilcat mountains. This line is the northern limit to which the country was generally glaciated during the Glacial Epoch. North of it the drainage is very perfect, the streams have a fairly regular current, being very rarely interrupted by rapids or falls, and lakes, as far as I am aware, are entirely absent. Recent terraces are not found at any very great heights above the sea, the highest observed, viz., some of those in the vicinity of Dawson, having a greatest elevation of about 1700 feet. They are either rock-cut or are formed of coarse sand and gravel, which have been well rounded and smoothed by stream and wave action. They would seem to have been formed on the shore of the ocean during a subsidence of the land, or possibly in a great lake formed by a differential elevation of the land when the drainage was assuming its present character. These terraces will again be mentioned under the head of "Geology."

South of the line of general glaciation, and within the region which was more or less completely covered by a vast *mer de glace*, or sheet of snow and ice, which stretched northward from the Chilcat mountains during the Glacial Period, the drainage is relatively very imperfect. Lakes occupy the bottoms of many of the valleys and depressions, the streams are in places sluggish, and in places are broken by swift rapids, for, since the ice withdrew from this lower country to the higher parts

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of the mountains, the streams have not had time to clear their courses of all obstructions and to assume a quiet, regular flow. Recent terraces are present up to great elevations above the sea, some of them along the north side of the Chilcat range in the vicinity of the Dalton trail having elevations more than 5000 feet. These terraces are for the most part formed by deposits of light grey silt or rock flour, which has been laid down over the glacial till, and is consequently somewhat later than it in age. In general character this silt is very similar to the white sediment brought down from the mountains by glacial streams at the present time, and it would appear to have been deposited near the mouths of small glacial streams where they flowed into lakes dammed back by glaciers, or against the sides of the large glaciers themselves. These

Small steamer on the Lewes river.

terraces, though so numerous and well marked on the landward side of the mountains, seem to be utterly wanting on their seaward side, for I could find no traces of them in the valleys of the Skagway or Chilcat rivers.

Hydrography.

The Yukon river which, with its branches, unwaters the whole of the Yukon plateau, rises in a number of streams and lakes in the northern portion of British Columbia. These discharge or flow northward and gradually come together to form the Lewes and Pelly rivers, which in their turn unite opposite Fort Selkirk, in N. lat. 62° 47′ 12″, to form one stream which is known as the Yukon from that point to the shore of Behring Sea. The total length of the Lewes-Yukon river, from the village of Bennett, at the head of Lake Bennett, to Behring Sea,

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according to the latest report of the United States Geological Survey, is 1865 miles. That portion of the river in Canada, between Fort Selkirk and the international boundary-line, has a length of 265 miles. The Lewes-Yukon river is navigable throughout, from its source to its mouth, for light draft stern-wheel steamers, except for a short distance at White Horse rapids and Miles cañon.

The principal tributaries of the Yukon river in that portion of Canada now under consideration, with their approximate lengths, are as follows:—

	Miles.		Miles.
Lewes, . .	390	Teslin, . .	160
Big Salmon, .	170	Nordenskiold, .	130
Pelly, . .	?	M'Millan, . .	?
White, . .	200	Stewart, . .	?
Klondike, . .	150	Forty-Mile, .	150

Lewes river rises in a number of long, irregular lakes fed by rivulets, some of which take their rise close to the very summit of the Chilcat mountains, while others gush from the feet of glaciers that move down their northern slopes. In the Chilcoot and White passes, the summits of which are respectively 3500 and 2866 feet above the sea, brooks rise within 18 miles of tide water in Lynn canal, and flow northward to Lake Bennett and the Yukon river, so short and steep is the slope on one side of the watershed, and so gradual is the slope on the other side. The largest and most important of the lakes discharging into the Lewes river are—Bennett, Atlin, Tagish, Marsh, and Labarge.

Teslin river and Teslin lake together have a length of 160 miles, and flow in a very direct north-westerly course to join the Lewes river 30 miles below the foot of Lake Labarge. It is navigable for very light shaft steamers at high stages of the water. The lake has a length of 60 miles, a width of 1 to 2 miles, and a depth of about 400 feet. The Nisutlin river, a stream from 200 to 400 feet in width, flows into the east side of this lake. It rises in the high mountains near the head-waters of the Liard river, and is from 150 to 200 miles in length.

Big Salmon river is a rapid shallow stream 100 to 300 feet in width, and 170 miles in length.

Nordenskiold river averages 100 feet wide near its mouth, and is about 130 miles long. It rises in Hutchi lake, which lies in the bottom of a wide, grassy valley, and flows northward, joining the Lewes river 20 miles above Five Finger rapids. The sides of its valley are, for the most part, gently sloping, and scarped banks are but seldom seen. The river may be ascended or descended in canoes, but is too small and crooked for steamboats.

Pelly river, with its tributary the M'Millan river, rises in the high, rugged mountains at the head of the Liard river, and after a general north-westerly course joins the Lewes river at Selkirk, where the confluent streams form the Yukon river. It is navigable for a long distance by light draft steamers.

White river rises in Alaska on the north side of St. Elias group of

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mountains, and flows at first eastward, across the international boundary, and then northward to join the Yukon 85 miles below Selkirk. Its waters are so heavily loaded with white mud or silt, doubtless carried down from the glaciers at its source, that after its junction with the Yukon it renders the waters of that stream quite white and opaque with mud. It has a total length of about 200 miles. It is entirely too swift and shallow for steamboats to navigate.

Stewart river flows into the Yukon from the east, 10 miles below the mouth of White river. It rises in the Rocky mountains near the head-waters of the Peel and Gravel rivers, and flows at first swiftly and then with a quieter current through extensive wooded or grassy plains. Except for one break at Fraser rapids, where the water flows swiftly over a rough ledge of schistose rock, the river is navigable almost from its source to its mouth by small stern-wheeled steamers.

Gold Commissioner's office in Dawson.

Klondike river rises in several small streams, which flow from the south-western face of the spur of the Rocky mountains that projects in towards the Yukon. It is a beautiful clear stream about 150 miles long, and 100 to 200 feet wide at its mouth.

Forty-Mile river rises in the rather high, but wooded mountains of the Ketchumstock range, in Alaska, and taking a general north-easterly course for about 150 miles, flows into the Yukon river 40 miles above where that stream crosses the international boundary-line. That portion of it within the Dominion of Canada is only 23 miles in length. It is a rapid stream of clear water, averaging, near its mouth, 100 to 120 feet in width, and with a depth of from 1 to 3 feet, and it flows in an extensive valley from 300 to 500 in depth.

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Neither of these last two streams is navigable by boats larger than canoes or small bateaux, which can be propelled against the stream with poles, or hauled along with lines from the banks.

Geology.

The geology of the Yukon district is only just beginning to be understood, though the characters of some of the rocks underlying parts of the country have been known since Dr. Dawson and Mr. M'Connell made their expedition through it in 1887.

Mr. Spur and others of the United States geologists have recorded a basal granite as occurring on the Tanana and White rivers, but up to the present I have not seen any granite, which I could distinctly identify as being basal rather than eruptive. Among the oldest rocks in the

Sawmill at Dawson.

country are undoubtedly the light green chloritic and micaceous schists, which underlie most of the gold-bearing region south-east of Dawson, and which have been called by Professor Nordenskiold, the Eldorado Schists. They are cut by many dykes and masses of dark basic eruptives, by some dykes of light-coloured acid eruptives, by some large masses and dykes of reddish porphyritic granite, and by wide veins and narrow stringers of white quartz. Associated with these schists, but probably overlying them, are outcrops of graphitic schist and beds of limestone. Similar dark-coloured schists, though not by any means always graphitic, associated with beds of limestone, now everywhere more or less crystalline, occur over a very wide area. They form the country rock along the Forty-Mile river, as far as I examined it, which was up to the mouth of Franklin gulch.

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Similar schists and lime stones are also found along the Dalton trail from the head of the Nisling river for a considerable distance southward. These are cut and broken by an elongated mass of porphyrite or rhyolite which extends in a north-westerly and south-easterly direction, and forms some of the highest peaks in the interior country, and they are also cut by masses of reddish granite.

The dark green schists and slates which rest upon and overlie the central granite of the Chilcat range of mountains are also not improbably of the same age.

Overlying the schists and limestones are thick-bedded conglomerates and dark clay shales, holding thin beds of coal and numerous remains of plants, probably of Cretaceous age.

Early spring at Bonanza Creek. Panning the gravel in order to estimate its value.

Light grey sandstones very similar to the Laramie sandstones of the plains east of the Rocky mountains, and like them, containing beds of lignitic coal, were seen to outcrop on Chandindu river about 20 miles north of Dawson City.

Within the glaciated area the bottoms and lower parts of the sides of the valleys are covered with a considerable thickness of unassorted sandy clay or till holding many glaciated pebbles and boulders, having evidently been formed as a ground-moraine beneath the glacier or glaciers, which extended northward from the Chilcat mountains for a couple of hundred miles into the interior. Overlying the till are many recent terrace deposits of sand and silt, apparently laid down in ancient glacial lakes. In both the till and the overlying terrace-deposits, when these are in the vicinity of the highly altered Palæozoic Schists, gold is occasionally found in small quantities, but up to the present no rich diggings have been found in these deposits.

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North of the generally glaciated region my study of the terrace-deposits has been almost exclusively confined to the Klondike district proper, so I may give a brief description of the conditions as they exist there, and of the causes which led to those conditions.

The Cretaceous rocks seen on Chandindu river are crushed and broken, so that they have shared to some extent, at least, in the disturbances that have affected the earlier rocks.

After the close of the Cretaceous Period the country was depressed about 4000 feet below its present level, and the vast denudation plain was formed which can now be traced over the summits of the hills and

Gold-mining on Eldorado Creek.

crests of the Yukon plateau. How long the region remained submerged is uncertain, but at some time during the Tertiary Period the land was raised, and the surface was carved by atmospheric and stream agencies into the rounded hills and wide, gently sloping valleys that now give the whole country its general contour. But the valleys were not at first cut down to their present depth. In the wide valley of the Klondike river the rock terrace 350 feet above Dawson represents the original floor of the valley when that valley was formed to its present width.

The conditions that prevail in this and similar valleys at the present time are as follows:—

The deepest part of the valley may be half a mile or more in width. In the Yukon valley near Dawson there is a well-defined terrace at an elevation of 200 feet above Dawson, but in the valley of the lower Klondike, except at its mouth, this terrace appears to be wanting, and instead there is a strong gravel terrace at an elevation of 625 feet above Dawson, resting on a bed-rock terrace beneath it at an elevation of 350

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feet above Dawson. The sides of the valley, up to the summit of this gravel terrace, are steep, and occasionally show rocky cliffs, while above the gravel terraces the slopes are very gentle up to the crests of the surrounding hills, so gentle in fact that it is usually difficult to determine, from the surface configuration alone, the line of the back of the terrace. This terrace is composed of sand and well-rounded gravel lying quite horizontally, which varies greatly in depth, in one place being found to have a depth of 275 feet, while in other places, and especially up the valleys of the tributary streams, it becomes gradually thinner. The lower portion of this gravel is usually whitish, and many of the pebbles are of white vein quartz, while its upper portion is yellower in colour and does not contain so large a percentage of quartz pebbles. When gold is present it is almost invariably found in the lower whitish gravel. As far as I am aware no fossils of any kind have been found in this terrace gravel. Above the level of this gravel-terrace, except in the bottoms of

Dumps of gold-bearing gravel piled up in winter.

little valleys, no rounded or washed gravel has been found, and the whole country is covered, often to a depth of many feet, with decomposed rock in place.

In the bottoms of the valleys there is also a deposit of rounded gravel usually from 10 to 20 feet in thickness. In this are found many trunks and fragments of spruce-trees, tusks of mammoths, and bones of bison latifrons, rangifer caribou, etc.

In the bottom of the valley of Bonanza creek, at the mouth of Skookum gulch, glacial striæ were beautifully shown on some harder parts of the underlying rock, after the overlying ground had been removed. From these striæ, as well as from the positions of some of the terraces terminating abruptly upwards in the valleys as if they had been formed in front of a wall of ice which has since disappeared, I consider

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that small local glaciers have existed in some of the northern-sloping valleys during the Glacial Period, when the country a hundred miles farther south was covered with a sheet of ice.

The sequence of events, after the great valleys had been cut down to the level of the higher rock terraces, would seem to have been as follows: —The country, in the northern portion of the Yukon plateau at all events, was depressed about 1700 feet below its present level, and the valleys were filled with gravel up to the tops of the present high terraces, the lower whitish gravel being possibly formed as a stream-deposit before the land was depressed to its greatest extent, the overlying yellower gravel being laid down as a dèlta formation over it. The country was then raised from the south-west, stream erosion again became very active, and the valleys were cut down far below their original floors, not, as a rule, across their whole widths, but along their northern and eastern sides,

Bench claims at the mouth of Monte Christo Gulch.

while terraces were left along their southern and western sides. At the same time small local glaciers were probably formed in the higher portions of some of the valleys.

It is possible that these deeper parts of the valleys were formed, or outlined by an elevation previous to the last great depression of the land, but as yet I have not been able to find positive evidence that such was the case. If such an elevation did occur we may expect to find deep channels or portions of channels, below the base levels of the ancient valleys, from which the gravel has not since been removed by erosion.

The valleys were cut down to rock floors which are almost everywhere below the bottoms of the present valleys, and a geologically recent slight decrease in grade has permitted gravel from 10 to 20 feet in thickness to accumulate in the bottoms of these valleys.

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Minerals.

For a number of years past gold has been washed from the sand bars on the Yukon river and on many of its tributaries, but it was not until 1896, when the rich diggings on Bonanza creek were discovered, that general attention was directed towards the Yukon district as a mining country. The total output of the Klondike district in the following year was about £500,000; in 1898 it was £2,000,000, and in 1899 £3,500,000, making a total of £6,000,000 in the first three years after discovery, while last year about £200,000 was recovered from the Atlin district, at the extreme southern limit of the Yukon basin.

As yet whatever gold has been found in payable quantities has been found in the bottoms of the valleys, or on terraces along the sides of these valleys. No rich quartz veins have been found, but it is in the highest degree probable that, where gold is found scattered in such abundance through the alluvial deposits, the veins or stringers from which it has been derived will be discovered, and that some of these veins or stringers, or aggregations of them, will be sufficiently rich to pay a profit over working expenses for extracting the gold.

Copper.—Native copper is known to have been obtained by the Indians from alluvial sands and gravels near the head-waters of White river, probably from both Canadian and United States territory. In 1898 several prospecting parties went out to look for the sources of this copper, but, as far as I can learn, without much success.

Copper ore is also reported as occurring in the rocks west of the White Horse rapids on the Lewis river, and some beautiful large specimens of bornite were shown me from near Rainy Hollow on the Dalton trail; but this locality, though within Canadian territory, is not strictly within the Yukon basin.

Lead.—Small lumps of galena were found in the dark grey plumbaginous schists near the mouth of Forty-Mile river.

Coal.—A low grade coal or lignite has been found in a number of places in the country, underlain by Cretaceous rocks, lying to the north and north-east of Dawson. Last summer a considerable quantity was mined on Coal creek, a tributary of the Yukon river below Forty-Mile river, and was brought up to Dawson. It seemed to bear transportation fairly well, and will doubtless furnish a very valuable supply of fuel.

Flora.

Throughout the Yukon basin the timber-line has a general elevation of from 3500 to 4500 feet above the sea, the former being about the elevation in the Klondike district, while it rises to the latter height in many places along the Dalton trail. On the islands, and intervales in the bottoms of the valleys, as well as in many of the gullies on the hillsides, white spruce (*Picea alba*) is often found up to twenty inches or even more in diameter, and with good tall trunks, so that three logs, twelve feet long and at least twelve inches in diameter, can be cut from a tree. On the Klondike river, and on Bonanza and Hunker creeks, such timber is growing in considerable abundance. Along the banks of the

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streams balsam poplar (*Populus balsamifera*) is often found of large size. On the more imperfectly drained places in the intervales, and on most of the hillsides, black spruce (*Picea nigra*) is usually growing with an average thickness of about six inches. It furnishes the principal supply of fuel used in the mines. With it canoe birch (*Betula papyrifera*) is growing to about the same size, while many of the drier benches are covered with small aspens (*Populus tremuloides*). The western jackpine (*Pinus Murrayana*) is found on some of the drier benches as far north as Five-fingers rapids on the Yukon river.

Trail through the forest near Bonanza Creek.

On the 30th of April of last year I made the following note in my notebook: "Walked up to the hill behind the town (Dawson) and found a large number of purple anemones (*Anemone patens*, var. *Nuttalliana*) in bloom. Mr. Cran, manager of the Bank of British North America, informs me that he collected them on the 21st inst., and that he saw them with others on the 16th inst." Next day, the 1st of May, I made the following notes: "Walked to the hill across the Yukon. On the sunny hillside many of the aspens are in flower, while the catkins are out on the birches, alders, and willows. Anemones are in great profusion, and *Saxifraga reflexa*? is beginning to open. The sage-bushes are soft and green, and the

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buds on the rose-bushes are reddening, ready to burst." May 14th: "The anemones are fading, but many other plants are beginning to shoot up. A pretty blue flower (*Polymomium humile*, var. *pulchellum*) is in bloom in a few places, and *Shepherdia Canadensis* is in full flower."

As yet very little attention has been given to gardening or agriculture, but excellent potatoes are grown both at Selkirk and Forty-Mile, and both at the latter place and at Dawson there are beautiful gardens in which are growing spinach, lettuce, cabbage, common and China kale, radishes, carrots, turnips, beets, and potatoes.

During the past summer I made a small and very imperfect collection of plants from the bottoms of the valleys, and from the lower hillsides in the Klondike district. Professor John Macoun, of the Geological Survey of Canada, kindly determined them for me. From this list some idea will be formed of the plant life of the district.

LIST OF PLANTS COLLECTED IN THE KLONDIKE DISTRICT IN THE SPRING AND SUMMER OF 1899.[1]

Anemone patens, Linn., var. *Nuttalliana*, Gray.
Anemone parviflora, Michx.
Anemone Richardsonii, Hook.
Ranunculus multifidus, Pursh, var. (?)
Ranunculus Lapponicus, Linn.
Aquilegia brevistyla, Hook.
Delphinium scopulorum, Gray.
Aconitum delphinifolium, DC.
Papaver nudicaule, Linn.
Corydalis glauca, Pursh.
Corydalis aurea, Willd.
Nasturtium palustre, DC. var. *hispidum*, Fisch. and Mey.
Arabis Holbœllii, Hornem.
Arabis lyrata, var. *occidentalis*, Wat.
Barbarea vulgaris, var. *arcuata*, Hook.
Erysimum cheiranthoides, Linn.
Erysimum parviflorum, Nutt.
Erysimum, Sp.
Brassica Sinapistrum, Boiss.
Draba incana, DC.
Lychnis triflora, var. *Dawsoni*, Robinson.
Cerastium maximum, Linn.
Arenaria capillaris, var. *formosa*, Fisch.
Arenaria lateriflora, Linn.
Arenaria physodes, DC.
Stellaria borealis, Bigel.
Lupinus arcticus, Watson.
Astragalus alpinus, Linn.
Astragalus frigidus, var. *littoralis*, Watson.
Oxytropis Lamberti, Pursh.
Hedysiarum boreale, Nutt.
Spiræa betulifolia, Pallas.
Rubus arcticus, var. *grandiflorus*, Ledeb.
Potentilla Pennsylvanica, var. *strigosa*, Pursh. (?)
Potentilla nivea, Linn.
Potentilla fruticosa, Linn.
Potentilla anserina, Linn.
Poterium Sitchense, Watson.
Rosa acicularis, Link.
Saxifraga reflexa, Hook.
Saxifraga heterantha, Hook.
Saxifraga tricuspidata, Retz.
Chrysosplenium alternifolium, Linn.
Parnassia palustris, Linn.
Ribes rubrum, Linn.
Ribes Hudsonianum, Richards.
Epilobium angustifolium, Linn.
Silenum Dawsoni, Coult. and Rose.
Cornus Canadensis, Linn.
Linnæa borealis, Gronov.
Viburnum parviflorum, Pylaie.
Galium trifidum, Linn.
Galium boreale, Linn.
Valeriana sylvatica, Watson.
Solidago multiradiata, Ait.

[1] Reprinted from the *Ottawa Naturalist* for December 1899.

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Solidago multiradiata, var. *scopulorum*, Gray.
Aster Sibiricus, Fisch.
Erigeron acris, Linn.
Achillea millefolium, Linn.
Artemisia vulgaris, Linn., var. *Tilesii*, Ledeb.
Petasites sagittata, Gray.
Arnica alpina, Murr.
Campanula uniflora, Linn.
Campanula rotundifolia, var. *Alaskana*, Gray.
Vaccinium cæspitosum, Michx.
Vaccinium Vitis-Idæa, Linn.
Arctostaphylos alpina, Spreng.
Arctostaphylos Uva-ursi, Spreng.
Cassandra calyculata, Don.
Andromeda polifolia, Linn.
Ledum palustre, Linn.
Ledum latifolium, Ait.
Pyrola rotundifolia, Linn.
Moneses uniflora, Gray.
Allotropa virgata, Torr and Gr.
Androsace septentrionalis, Linn.
Gentiana Amarella, var. *acuta*, Hook.
Polemomium humile, var. *pulchellum*, Gray.
Mertensia paniculata, Don.
Pentstemon cristatus, Nutt.
Castilleia pallida, Kunth.
Pedicularis euphrasioides, Stephan.
Dracocephalum parviflorum, Nutt.
Chenopodium capitatum, Benth. and Hook.
Polygonum alpinum, Linn.
Shepherdia Canadensis, Nutt.
Comandra livida, Richardson
Betula papyrifera, Michx.
Betula glandulosa, Michx.
Alnus incana, Willd (?)
Salix arctica, R. Br.
Salix Scouleriana, Bebb.
Salix reticulata, Linn.
Salix—— (?)
Salix—— (?)
Populus tremuloides, Michx.
Empetrum nigrum, Linn.
Juniperus communis, Linn.
Pinus Murrayana, Balfour.
Picea nigra, Link.
Picea alba (?)
Corallorhiza innata, R. Br.
Calypso borealis, Salisb.
Allium Schœnoprasum, Linn.
Zygadenus elegans, Pursh.
Eriophorum capitatum, Host.
Carex Pyrenaica, Wahl.
Carex invisa, Bailey.
Carex—— (?)
Carex concinna, R. Br.
Deyeuxia purpurascens, Kunth.
Poa pratensis, Linn.
Equisetum arvense, Linn.
Pellæa gracilis, Hook.
Phegopteris Dryopteris, Fée.
Aspidium fragrans, Swartz.
Cystopteris fragilis, Bernh.
Cystopteris montana, Bernh.
Woodsia glabella, R. Br.
Woodsia hyperborea, R. Br.
Lycopodium obscurum, Linn.
Lycopodium annotinum, Linn., var. *pungens*, Spreng.
Lycopodium complanatum, Linn.
Polytrichum juniperinum, Willd.
Marchantia polymorpha, Dum.
Cetraria juniperina, var. *pinastri*, Ach.
Usnea Barbata, var. *dasypoga*, Fr.
Alectoria jubata, var. *implexa*, Fr.
Peltigera aphthosa, (L.) Hoffm.
Cladonia gracilis, var. *hybrida*, Schær.
Cladonia rangiferina, var. *sylvatica*, Linn.
Cladonia deformis, (L.) Hoffm.
Cladonia cornucopioides, (L.) Fr.

The above plants were all collected in the bottoms, or at no great height up the sides of the valleys, at approximate elevations of between 1000 and 1500 feet above sea-level. The principal locality visited on the Klondike river was a gravel hillside, sloping towards the south, within a short distance of the town of Dawson. Another locality was a rocky hill, also facing the south, a couple of miles farther up the valley. The localities on Bonanza and Hunker creeks were either on the swampy flats

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or on the swampy hillsides. Chandindu river was visited once, on June 13th, and the plants, as labelled, were collected either on the wide swampy flat in the bottom of the valley, on a grassy hillside on the north side of the valley, or on a sandy bar at the mouth of the river where it joins the Yukon river. Forty-Mile river was visited for a few days between July 29th and August 8th, and the plants were collected close to the banks of the river as we ascended and descended in a canoe.

Fauna.

In the gold-bearing gravels in the bottoms of the valleys tusks of mammoths (*Euelephas primigenius*), horns and skulls of buffalo (*Bison latifrons*?), horns of caribou (*Rangifer caribou*?), and bones of several other species of large animals are often found, but the mammoth and the wide-horned buffalo are now extinct.

Indians travelling in winter with dogs.

Moose (*Alces Americanus*) are abundant in all the unsettled parts of the country, or where the miners and prospectors have not killed them off. Their shed horns may be seen lying in profusion among the willows and dwarf birches on the summits of the ridges. Caribou (*Rangifer Grœnlandicus*) are reported to cross parts of the country in great numbers on their annual migrations to and from the shores of the Arctic Ocean. Mountain sheep (*Ovis Dalli*) and mountain goats are found in the mountains. Bears, wolves, otter, marten, and lynx undoubtedly exist in small numbers, but are very seldom seen. The red squirrel (*Sciurus Hudsonius*?) lives everywhere among the spruce woods, and a spermophile (*Spermophilus Parryi*) is found in great numbers on the drier benches in the southern part of the district.

Of birds, the raven (*Corvus Corax*), the Canada jay (*Perisoreus*

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Canadensis), and a small red-poll winter in the country, while many other birds live in the country, or pass over it on their way to their nesting-grounds farther north.

King and dog salmon ascend the Yukon river and many of its tributaries, and are caught in large numbers opposite the town of Dawson and elsewhere. They furnish an important local source of food-supply. Graylings, up to one foot or rather more in length, are caught in Klondike river and in many other of the clearer streams.

The natives, who are sparsely scattered over the country, and who formerly lived by hunting and fishing, belong to the Athabascan or Tinne stock.

I cannot dismiss this subject without saying a word about the mosquitoes, as they have been represented as one of the greatest hardships to be endured in the Yukon country. On the swampy land in eastern Canada, and around the shores of Hudson Bay, they indeed seriously interfere with the comfort of living during the early summer, but through the two summers that I have spent in the Yukon district there was only one night when I was seriously annoyed by these pests, and that night I was camped on a low, willow-covered island in the Yukon river. On the gold-bearing creeks, if they ever existed, they have now almost entirely disappeared.

Of domesticated animals, dogs, both native and introduced, the latter being of all kinds, from the St. Bernard to the bull pug, are much used to haul loads over the snow and ice in winter, and sometimes to carry loads on their backs over the narrow trails in summer. They live and thrive splendidly.

Horses were first used in the district by Messrs. Glave and Dalton about 1891, and were found to thrive well on the native grasses. In the last couple of years great numbers of horses have been brought into the country. Last winter a large band of horses belonging to the Canadian North-west Mounted Police was allowed to run loose over the hills and valleys near Tagish, without attention, and almost all of them were found in fairly good condition in the spring; another band roamed at will all winter near the mouth of the Nordenskiold river, and was brought down to Dawson in the spring. It is also commonly stated, and I think correctly, that a horse, which in the autumn had been turned out to die, as the owner had no food to give it, passed the winter in the hills back of Dawson, and that in the spring it was again caught by the owner and put to work.

Mules and donkeys are also used in freighting supplies from Dawson to the mines.

Cattle have been brought in in large numbers, and last summer there were at least two dairy farms in the Klondike district supplying milk to Dawson.

Climate.

The climate of the Yukon basin is dry, with, as a rule, but slight diurnal variations in temperature. The annual precipitation is from ten to twelve inches, most of which falls in the autumn and early winter.

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High winds are rarely known, the highest wind recorded in Dawson in February last being only ten miles an hour. The thermometer varies from 90° F. in summer down to −50° in winter, but in the dry calm air no inconvenience is ever felt from this low temperature. A lady who lived in Dawson last winter informed me that not once last winter was she prevented by inclement weather from taking her regular constitutional walk of from two to four miles a day.

In speaking of the plants enumerated above, Professor Macoun says, "A mere glance at the following list will show that the spring and summer climate in the vicinity of Dawson is as mild as that many degrees farther south in eastern Canada; indeed the great majority of the plants found in meadows, bogs, woods, and river-bottoms grow within one hundred miles of Ottawa." These words are eloquent of the character of the summer climate, and I believe that every one who has

Stopping-place for travellers on Hunker Creek.

been in the Yukon district, and who has been warmly clothed and housed, and well fed, will agree with me in stating that the winter weather, too, is exceedingly pleasant and healthy.

Transportation.

The means of access to, and communication with, that northern country are changing and improving so rapidly that what is said of it to-day will be obsolete to-morrow. Two years ago very few people had a correct idea of the easiest way of reaching the Klondike gold-diggings, and men started into the country by many different routes, among which were the Chilcoot pass, the White pass, the Chilcat pass and Dalton trail, the Copper river, the mouth of the Yukon river, the Stikene river, and the Edmonton route, which in its turn divided into many different

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ways across the divide between the Mackenzie and the Yukon rivers, almost every pass across the mountains being tried from the Peace river northward to the Peel river. Some of these people reached Dawson quickly, while others kept straggling in throughout the whole of last summer, having been more, and often much more, than twelve months on the way.

Now there are just two routes in ordinary use, one by ocean-going steamers from the Pacific coast ports to St. Michaels, near the mouth of the Yukon river, and from there by powerful flat-bottomed steamers, many of which carry as much as five hundred tons, and have excellent passenger accommodation, for 1370 miles up the Yukon river to Dawson. This is the most economical way to bring in heavy freight, but on account of the longer time occupied on the journey, it is not used to any great extent for passenger traffic.

The other way is by ocean-going steamers from the Pacific coast ports, but chiefly from Seattle, Victoria, or Vancouver to Skagway, the average time occupied on the journey being from four to five days. At Skagway passengers take the White pass and the Yukon railway to Bennett, at the head of steamboat navigation on the Yukon river. Here large steamers are waiting to take them across the lakes and down the river to White Horse rapids, where they are taken on a horse tramway past the rapids to other steamers waiting below, which in their turn, after a journey of two or three days through some of the grandest scenery in the world, take them to Dawson, the metropolis of the gold-fields of the Klondike district. The journey in summer from Vancouver can be made in from seven to ten days. My partner, Mr. Green, made the journey from Ottawa to Dawson in fourteen days, only eleven of which were actually consumed in travel, while many others covered the distance in shorter time. At present the White pass and Yukon railway is being pushed on to White Horse rapids, and before the close of another year we hope to be able to travel to the Klondike district with only two breaks in the journey from Vancouver, namely from the boat to the train at Skagway, and afterwards from the train to the boat at White Horse rapids. Within a few years we may see a railway southward through British Columbia to connect with the great trans-continental line of the Canadian Pacific railway.

By way of the White pass mails reach the country and leave it about once a week in winter and summer, but for a few weeks in spring and autumn, while the ice is breaking up on the streams, and again when it is forming, the mails are irregular or discontinued. Now, however, a telegraph line is in operation between Skagway and Dawson, and though there is as yet no telegraphic communication between Vancouver and Skagway, the messages are forwarded by mail between these two places. On September 28th, the evening on which the line was opened, we had the pleasure of sending a message from Dawson to Ottawa, and it reached its destination in five days, and only the other day, while in Ireland, I received a telegraphic message from Dawson. Thus this most distant part of the North American continent is now brought into close touch with the very heart of European civilisation.

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THE CORDILLERA OF MEXICO AND ITS INHABITANTS.

By O. H. HOWARTH, C.E., F.R.G.S., F.G.S.

(*Read at the Society's Hall, December 14th*, 1899.)

MOST of us have experienced the fact, that in forming our conceptions of a country which has not become familiarised to us geographically by any special acquaintance, there is always a tendency in our minds to underestimate the elements of space and distance. It may be as well, therefore, that by way of preface to this description we should note a few general features of the Republic of Mexico which are scarcely realised in the general mind, and are frequently the subjects of more or less misconception.

Group of Pueblo Indians.

From the southern frontier of the United States on the Rio Grande to the northern frontier of Guatemala, Mexico occupies a length from north to south of about 1500 miles, with a width varying from about 900 miles at the northern boundary down to a minimum of 120 miles at its narrowest point in the isthmus of Tehuantepec, after which it widens again in the States of Yucatan, Campeche, and Chiapas. The Republic includes thirty-one States and Territories, of which three or four are each of larger area than Scotland, and two larger than England and Scotland together. Each State is divided into counties or districts, with their capital towns and municipal subdivisions. In general structure the entire country is an elevated plateau, with but few districts lower than 4000 feet altitude above sea-level, and with extensive tracts of 5000 feet and upwards. The valley of the city of Mexico is over 7000 feet in

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altitude. The only exceptions to this are the two belts of low-lying land called the *tierra caliente*, or hot country, bordering the Pacific and Gulf coasts, and varying from 20 to 50 or 60 miles in width. Hence, although so large a proportion of Mexico lies actually within the Tropics, it is only these latter regions which possess what is commonly understood by a tropical character. Neither the climate nor the vegetation of the interior are "tropical" in that sense, the former being distinguished by its comparatively small variation between summer and winter, and its healthy and invigorating qualities in most parts of the country. There is, perhaps, no finer atmosphere in the world than that of Mexico at all elevations between 5000 and 8000 feet. In the northern States, where there are extensive tracts of desert land, the rains are irregular and

La Cima, the highest pass on the Mexican Railway.

sometimes absent for many months together; but south of the 24th parallel, that is to say within the tropical line, they occur during the summer season, between May and October, with only seasonal variations. At all the ordinary altitudes, however, the rainfall occurs almost exclusively in the afternoon and evening, and a morning shower is quite exceptional. From November to April the weather is uniformly brilliant and rain very rare. In the mountain districts a few light showers, known as the *equipate*, sometimes occur in January.

Mexico contains, strictly speaking, two Cordilleras, or continuous mountain ridges, forming the boundaries between the high lands of the interior and the eastern and western belts of the coast; but the western Cordillera, or Sierra Madre, is the subject of our present notice. It forms, in fact, a link in the greatest mountain range of the world, which extends practically almost without a break from Alaska to Patagonia, over nearly

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the half circumference of the earth. After crossing and penetrating this vast range at many points throughout the northern continent, between Oregon and the south of Mexico, it has appeared to me that the Mexican range possesses features of interest in many respects exceeding those of any other part of the series. It is distinguished by the remarkable uniformity in the altitude of the highest ridges, between 10,000 and 11,000 feet. The exceptions to this are chiefly the recent volcanic peaks, which, with the exception of Colima, lie somewhat out of the general line. These highest peaks, including Popocatepetl, Ixtaccihuatl, and Colima, are the only points where snow is perennial, and on these, even at an elevation of 17,000 feet, a large portion of it disappears in some seasons. Snow lies, however, as late as March and April on parts of the main ridge at 10,000 or 11,000 feet.

Mexican prairie schooner.

The general structure of the range is that of a narrow and very deeply fissured fold in the earth's surface, the enormous chasms in the central parts of the range giving rise to a magnificence of wild scenery unsurpassed in the world. It is no uncommon occurrence in following a trail across the Sierra to descend as much as two or three thousand feet and reascend to the same, or greater heights, three or four times in the course of one day's ride; and in no Spanish-speaking country does one meet more frequently with the name of *Quebrada Honda*, or "Broken Depth," as applied to these precipitous cañons. As a result of this structure the erosion of stream beds has of course been, in a geological sense, rapid. All the rivers flowing to the Pacific coast are consequently short in course, and subject at times to high and sudden floods. Within my own recollection, at least one small town on the low lands, a few

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miles from the western shores, has been entirely swept away. On making arrangements for a recent journey, and mentioning my intention to stay at a village where I had frequently halted for the night in former years, I was quietly informed "there is no such place now."

Another result of the deep fissuring of the surface within these limits is that nearly all the mineral veins of the range, from which such vast wealth has been extracted in precious metals from prehistoric ages, are nearly vertical in position. Countless instances are met with of the amazing richness of the mineral products of some of these treasure-spots; and almost fabulous as some of them sound, they are borne out by facts in many cases. I have myself seen a natural globe of solid silver the size of my head, and many a specimen of ore carrying silver in the pro-

Summit of Popocatepetl.

portion of six or seven thousand ounces per ton. The cathedral of the city of Chihuahua is said to have been erected (at a cost of $200,000) out of a church tax of three cents per pound weight of silver bullion produced by a single mine in that State. Facts like these have doubtless given rise to plenty of modern romancing about mines, yet they remain a basis for much of the peculiar fascination which belongs to Mexico and its history.

The same process of erosion amongst the porphyritic rocks, which constitute so large a bulk of the western Cordillera, has left traces in several unique examples of weathered boulders. To one of these, standing in a remote cañon in the State of Sonora, I gave the name of "Queen Eleanor," from its singular resemblance to a majestic figure of that personage in an old engraving. Two years ago, while crossing the range between Mazatlan and Durango, I met with an extraordinary group of

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weathered boulders at the edge of a small mountain plain, called the Llano de Rusia. There were a hundred or more in the cluster, and the upper half of each one had become worn by the action of rain into a perfect cone, giving all the appearance of artificial working.

These Llanitos, or "little plains," form an interesting feature of the high ranges, occurring frequently amongst the roughest ridges, and in singularly unexpected positions. They are usually level plateaus from half a mile to several miles in length, generally covered with fine soft grass, and frequently used as pastures for cattle. In some instances they represent the "divide" of a watershed, and are intersected by a water-course in which, even within so short a space as half a mile, the stream at the two ends will be found flowing in opposite directions. In the Grand Llano on the Durango side of the Sierra I rode a distance of thirty miles on a level plain at an altitude of over 8000 feet, after which

Miztec's family and house.

the "broken depths" recommenced. The llanitos are usually open spaces, free from the pine forest which clothes the ranges generally, but on the larger ones, such as the above, scattered trees of other species are found.

Towards the south, in the States of Puebla, Oaxaca, and Chiapas, where the continent narrows, the ranges are more broken, and the eastern and western chains meet, with broad valleys intervening. In one of the highest valleys in Oaxaca, at an altitude between 8000 and 9000 feet, I found an unexpected industry in the form of an "ice-factory." The ground was covered with a vast number of shallow wooden troughs, which are filled at nightfall with water from the dividing stream, and during the nights of the winter months this becomes covered with a film of ice not more than an eighth of an inch thick. In the morning this is removed and shovelled into holes in the ground, and covered up with earth, after which it consolidates, and is cut out in blocks and sent down by mules into the towns, where there seems to be a ready market at all seasons.

Most of the highest elevations are thickly covered with pine and with mountain oak which, with some other smaller growths, afford an

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unfailing supply for the charcoal burners who pursue their calling under government licence anywhere on the mountain lands which are not privately owned. For the purpose of supplying mills and other factories with fuel, charcoal is frequently carried as far as twenty to thirty miles on donkeys at an extremely low rate. Smaller vegetation is very abundant and in great variety—including many flowering shrubs in the deeper cañons, and, near stream-courses, a selection of ferns, which would furnish a happy hunting-ground for the fern-fancier, were they only somewhat more accessible. The hardier kinds occur at remarkable altitudes; in climbing the spurs of Ixtaccihuatl I found a delicate maidenhair fern flourishing at an elevation of 10,500 feet, not far from the snow-line.

In entering and crossing the range one is struck with the apparent paucity of animal life, though on closer acquaintance this appears to be due to the fact that it is not very obvious at first sight. All centres of population, such as the mining-camps, have driven the animal denizens of the mountains into less frequented localities, and on getting away from beaten trails a variety of game can be found. The white-tailed and black-tailed deer, two or three species of antelopes, bears, and wild hogs are among those which I have encountered on remote trails. The so-called tiger (the Mexican jaguar) sometimes ascends from the hot lands to the jungle-covered foothills to an altitude of 2000 or 3000 feet; but as the Mexicans entertain a wholesome fear of this very pugnacious creature it is not much hunted, and its extremely beautiful skin fetches a good price. Of smaller animals, the wild cat, the armadillo, and a small rat are found at considerable heights, and the coatimundi in the foothills of the south. Some large species of lizards, including the iguana, are also frequent up to 3000 feet.

Reptiles are but few anywhere on the high lands, and those which are met with in the Cordillera must be regarded rather as wanderers from the *tierra caliente*. Snakes are comparatively rare except in the extreme southern parts of the range, and mostly of non-venomous varieties: the only poisonous specimen I have met with at an altitude if 5000 feet is a small coral-snake. Noxious insects are also remarkably few in the mountains. A small red scorpion (*alacran*) is, however, tolerably common up to 6000 or 7000 feet, and as a domestic acquaintance is to be avoided. Mosquitos, of course, occur at spots where the conditions are favourable to their propagation, but these are infrequent on the range. I have never seen a wasp in any part of Mexico.

Bird-life is also by no means abundant; and the absence especially of small birds in the vast forests of pine and undergrowth, is very striking. Of larger species, the common buzzard is universal, and may be seen at the highest altitudes as frequently as on the coast. A considerable variety of eagle-hawks, kestrels, owls, and woodpeckers frequent the foothills: also some forms of gallinaceous tree-fowls, known as the Quiche, Chichalaca, and others, may be recognised by their powerful calls resounding through the deep cañons, and sometimes mistaken for the creaking of a cart-wheel, or a primitive sugar-mill. The strange and brilliant notes of the Tzentzontli, or "bird of a hundred voices,"

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according to the poetical Indian name, are also frequently heard re-echoing in the warm barrancas on the Pacific side of the range. Owing to the wary and elusive character of this bird it is always most difficult even to see, and when caught and caged as a domestic pet is valued at a high price. On the western coast large flocks of parrots of several varieties habitually make daily excursions up into the range to an altitude of several thousand feet in search of certain seeds or fruits which furnish them with food at those elevations. The parrot is not commonly regarded as a bird of long flight, but I have noted the coming and going of these loquacious crowds from the hot lands to the high ridges and back, occurring with such regularity that the morning and evening hours could be fixed with precision by their passage, and this in localities where their flight must have covered at least a hundred miles a day.

Group of Indians.

The western range affords a peculiarly interesting field of research for the butterfly collector, owing to the dovetailing of northern and southern forms throughout Mexico. The former, spreading down from the north in the climate of the high lands, intermingle with the latter passing up the tropical coast-belts, so that a single day's catch in any of the western cañons will often include an extraordinary variety of representatives traceable over nearly the whole of the North and South American Continents.

In describing the human inhabitants of the great Cordillera of Mexico, one may regard them as divisible into three distinct groups, though of course the rapid introduction of foreign commercial interests leads to more or less fusion between these which must tend to obliterate such distinction as time goes on. They may be designated, however, as (1) the aboriginal or Indian population; (2) the modern or business population, concerned largely with mining and allied trading pursuits; and (3) a curious kind of "odd-man-out" population, which may be

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described as the waifs and strays, consisting of scattered individuals or families whose presence in the remote mountain nooks of the great range is often difficult to account for except through the chapter of accidents, and forms an interesting subject of inquiry.

From the archæologist's or ethnologist's point of view, the first of these must naturally afford by far the most inviting field of investigation, though I cannot venture, within the limits of this paper, to enter upon so absorbing a line of inquiry—tempting as it proves to every traveller. It may be observed, however, that the particular interest of this human group is much on a parallel with that of the butterflies. By a somewhat similar process Central America has constituted from immemorial ages a meeting-ground of the northern and southern sections of the race, reinforced from time to time by chance drifts of Asiatic types across the western ocean, and leaving at this day a mere remnant after the continual struggle for supremacy. The few surviving families of Apaches, Taramaris, Cotas, Yaquis, and other mountain tribes, are rapidly undergoing absorption, as one after another is led gradually to discover that industry pays better than fighting. As missionaries of civilisation we may welcome this phase of progress—as students of antiquity we must lament that the cloudy romance of their past history will in a very few years be obscured finally and for ever.

The isolation of some of the remaining tribes which continue wholly distinct in physique, language, and customs, is a singular feature, and especially so when observed in closely adjacent localities—as, for instance, in two adjoining cañons. The different degrees of aboriginal civilisation which seem to have been inherited in different cases, are extremely remarkable—some tribes living in squalid poverty, while others are found to possess a considerable refinement in their way of life and customs, as well as industry in their pursuits. Amongst some of these who have come in contact with even Mexican civilisation it is curious to notice that the fact of being an "Indio" is associated with a certain sense of reproach, and an anxious desire is sometimes evinced to claim "Mexican" nationality as well, the idea being evidently connected with a more advanced phase of existence.

In fact, the term "Mexican," in a general sense, must now be taken as representing a distinct nationality. Though originating, of course, in a fusion of races, the lapse of three or four centuries may be said to have established such a nationality; and though the Spaniard lays claim to the bluer blood of the mother country, his superiority on that account is by no means acknowledged by his cousin of true Mexican descent. "We are Indians, certainly," said the "Presidente" of an Oaxaca mountain-village to me the other day; "but then we are also Mexicans, and we—" etc., etc., proceeding to recount all their habits of hospitality, industry, and so forth, as claims to a far superior birthright. The warlike sections of the Indian race are rapidly becoming extinguished. Even the once-dreaded Apache, whose appalling war-cry has been heard by many now living, is sharing the same destiny. In traversing the wildest part of the Sierra Madre in Sonora, a few years ago, I could only hear of some few families of them as still occupying unknown mountain fast-

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nesses, and occasionally causing trouble by raiding the cattle-ranches on the east of the range. For the most part the tribes between the north-west and the far south are small of stature, and inoffensive in their character, but in the southern States of Oaxaca and Tehuantepec the Zapotecos, a people of superior physique and intelligence, represent probably all that remains of the ancient Mayas whose progenitors left behind them the wonderful structures and traces of civilisation which afford so profound a problem to the archæologist of Central America.

The modern population, gathered chiefly about the mining centres, consists of a mixture of Europeans and Mexicans, with more or less of an Indian contingent in their employ, according to locality. One of the most remarkable characteristics of the mountain Mexican is what may be

Mining camp in Oaxaca.

termed his hereditary poverty—his placid acceptation of all sorts of adverse conditions of life without the slightest effort to remedy them, even when the means lie at his hand. Many a time I have found the occupants of a mountain ranche living in the extreme of exiguity in a country and climate where not only ordinary comforts but even luxuries could be furnished by the smallest thrift and with a minimum of labour. But it was not the way of their forefathers to do or desire such things; and even actual physical suffering does not seem to prompt them to the attempt. Many a night I have passed at such a location, where what we should term necessaries—such as milk, eggs, fowls, and vegetables—could have been provided with next to no trouble, yet where the native *tortilla* and *frijol* (flour cakes and beans) were the only subsistence ever thought of, and sometimes one or other of these would be wanting. Scarcely a log to sit down upon, or a bed of rushes to sleep on is preferred to the bare ground, not to mention such an unwonted refinement as a table to eat off. A fire on a frosty night is a proscribed luxury; and I have seen a crowd of victims of bronchitis and influenza lying about on the floor

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of a *jacal* (hut of sticks) throughout a bitter night, with the wind whistling through the walls, in a log-ranche where enough broken wood lay scattered around to have cremated the whole population of the Republic. But although these hapless folks would avail themselves of my fire when I took the initiative and made one, it never seemed to occur to them as a necessity, and my proceedings were regarded with a smile of surprise. It is scarcely to be wondered at that brigandage and highway robbery are little to be feared at the hands of such a people; and although, of course, this curious persistence in misery is not a general characteristic of the Mexican everywhere, the risk of mistreatment to travellers in the mountains is now very small. Attacks of any kind are infrequent, and usually the result of design where a particular booty is

Open rocks, Mexico.

in view. As a rule, the mountain folk are of a sympathetic and kindly disposition, and trustworthy in matters of any importance, though frequently the most incorrigible pilferers on a small scale. The European ingredient in this population is, of course, such as may be seen in any country where modern methods of industrial enterprise have been introduced.

The sparsely scattered mountain population which I have described as waifs and strays are of uncertain nationality, and perhaps can hardly be distinguished except by individual examples. They seem to consist of persons or families, whether Mexican or foreigners, who by varying chances of fortune have drifted into the mountains and taken up their abode at remote spots, with no more inducement than that which leads a rabbit to domicile itself in a particular hole, or a bird in a particular tree. Their provision for existence is usually seen in a small corn-

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patch, or, if amongst the lower cañons, a patch of sugar-cane with a crude antiquated mill, or possibly a private mine on some by-streak of silver-bearing rock; and their personal history, if it can be got at, may supply the passer-by with a romance outdoing the products of fiction.

Among many such instances, I recall an old soldier who I found had been in the Imperial Guard under Napoleon III., but had entirely lost his own language, though unaccountably remembering a few words of English; another ancient Frenchman, residing in a solitary hut at an altitude of 9000 feet on one of the highest ridges of the Cordillera, who recovered some facility with his native tongue after conversing in it for an hour or two, and who surprised me with a detailed account of the construction of the Mont Cenis tunnel; a mountain guide in the wilds of Chihuahua, who proved to be of English birth and evident education, but whose identity and history I could not venture to elicit; a Spanish scout who had been present at the execution of Maximilian, and spoke of that tragedy with bated breath: to each and all of these belonged a story of adventure which, if I were to give it in detail, might well be taken for a work of imagination. The freaks of fortune, or rather of misfortune, which had brought these wanderers to a halt at such remote and unexpected spots, were indeed, as may often be said of real life-stories, much too strange not to be true.

To appreciate the full interest of such research as is afforded by travel off the few beaten tracks in this mighty range, one would need to possess acquirements comprising nearly all the sciences, together with such powers of observation and memory as no individual was ever yet gifted with. Many of the sources of such interest will doubtless continue to exist indefinitely; and of those which must needs be lost as time progresses, it is to be hoped that some at least may be further studied and their results gathered in before the active broom of civilisation sweeps them away.

THE PROPOSED SCOTTISH NATIONAL ANTARCTIC EXPEDITION.

By William S. Bruce, F.R.S.G.S., M.B.O.U.

Two important expeditions are being fitted out to explore the Antarctic regions in 1901. One of these sails from Germany, the other from Britain. It is not at all possible that these two ships can explore the whole of the Antarctic regions. The leader of the German Expedition, Professor Erich von Drygalski, says, "Should the British Expedition include a second ship, it would be possible to carry on biological deep-sea research round the Antarctic area over a much wider circle than we can attempt with one vessel."[1] Other autho-

[1] *Nature*, vol. lxi. No. 1579, 1st Feb. 1900, p. 321.

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rities have strongly advocated a second British ship. "Two ships," says Sir John Murray, "not exceeding one thousand tons, should, it seems to me, be fitted out for a whole commission, so as to extend over three summers and two winters."[1] While Professor James Geikie says, "Two ships, at least, are required—adequately supplied with material and men, including, of course, a trained scientific staff." "Here, then," he continues, "is an opportunity for patriotic Scotsmen! In Germany every one, from the Emperor downwards, will do what can be done to make their expedition complete and a credit to the Fatherland. We cannot afford to do less, and it is to be hoped that some wealthy Scotsman or Scotsmen will come forward to emulate the munificence of Mr. Longstaff, so that the expedition that leaves our shores next year may be one in every way worthy of a country which has so great a reputation to maintain."[2] These recommendations and appeals have not, however, resulted in producing funds sufficient for this purpose, and the Expedition will have to leave London with only one ship, which is being especially built and fitted out for magnetic research.

Professor von Drygalski has pointed out that "an expedition from a third side would find a wide and important field of activity to the south of South America." It is now proposed that a third expedition such as this should sail from Scotland as a Scottish National Antarctic Expedition, which will co-operate with the other expedition, and devote its attention more especially to physical and biological oceanographical researches and to geology and meteorology.

The Germans will concentrate their attention to the south of the Indian Ocean. "The point which the German Expedition has in view for commencing the penetration of the Antarctic region is the still hypothetical Termination Island."[3] An effort will be made to establish a station on land to the southward of this. The main work of the British Expedition[4] will lie in M'Murdo Bay, their winter headquarters, and the adjacent coasts or ice-barriers for a considerable distance on each side. The Scottish Expedition will work to the south of South America, in the Weddell Sea, setting up its wintering-station on the east coast of Graham's Land, in a high southern latitude.

The Scottish vessel will be one of the ordinary Norwegian or Scottish type of whalers of about 500 tons, 130 feet long, and steaming 7 to 8 knots. A ship of this size will have ample accommodation for thirty-seven all told. The proposed staff includes 6 scientists and 5 ship's-officers, and a crew of 26. The ship will proceed from Scotland on August 1st, 1901, to Port Stanley, in the Falkland Islands, which will form the base for operations in the Antarctic regions. She will proceed southward by Weddell's track in 30° W. This route has never yet been tried seriously with a steamer. Weddell, in 1823, penetrated far south with two

[1] *Geog. Journal*, vol. iii. No. 1, Jan. 1894.

[2] *Scot. Geog. Mag.*, vol. xv. No. 5, May 1899.

[3] *Nature*, vol. lxi. No. 1579, 1st Feb. 1900, p. 319.

[4] "The Antarctic Expeditions," by Sir Clements Markham, K.C.B.—*Geog. Journal*, vol. xiv. No. 5, p. 480.

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sailing ships, one of 120 tons and one of 65 tons: Bellinghausen also was successful a little farther eastward. Ross, with sailing-ship, failed, but Larsen, with a steamer, reached 68° S. in about 60° W. The Dundee whalers, in 1892 and 1893, being on commerce bound, were chiefly occupied securing seals, and since these abounded in the vicinity of the Circle they had no need to go farther south. There is little doubt that the ice can be penetrated by such a vessel as that above mentioned. The ice I saw in 1892 and 1893, and worked amongst in 50° to 60° W. in the vicinity of the Antarctic Circle, is very similar, and is certainly not so heavy as East Greenland ice, in which ships like these navigate every year.

The writer will take command of the expedition with a whaling captain under him and four other officers, a naturalist will be permanently attached to the ship, and will take charge of and carry on the scientific work there during the leader's absence with the wintering party. The land party will land in a high latitude on the east coast of Graham's Land, and the ship will return northward for the winter.

The landing party will consist of five scientific men and two skilled workmen. The leader is included in this number. Systematic observations will be taken, and collections made. The ice both on land and sea will be studied—its physical state, the movements of glaciers, salinity, etc. In the spring sledge journeys with dogs will be undertaken for topographical and other purposes. I have seen fast land floe-ice in the Antarctic that could be travelled over with dogs, sledges, and ski; and I have no doubt that useful journeys could be made on the inland ice. In 1902 the ship will return south to relieve the wintering party and to re-supply it with fresh food. If there is occasion and opportunity further exploration will be made with the ship in the summer months in that region, before she returns northward for the second winter. A second winter will be spent at the station, and a final return made during the third year, unless funds allowed the expedition to stay another winter.

Professor von Drygalski, Sir John Murray, and other eminent men of science have recently set forth what the work of a modern Antarctic expedition must be. It is scarcely necessary for me to reiterate what they have said. I may, however, point out a few of the many important problems that will present themselves especially to the Scottish Expedition along the route it intends to follow. The voyage to the Falkland Islands will be made as quickly as possible, using coal freely. The first stop will be to coal at the Cape de Verde Islands, after which a course will be steered for a point 15° 3′ S., 23° 14′ W., where Ross did not obtain soundings with 4600 fathoms of line. This sounding, as far as I can ascertain, has been entirely overlooked, and has remained unchartered except in James Imry and Son's chart of the South Atlantic, where it is marked with a query. Here a sounding will be made to prove or disprove the accuracy of Ross's sounding, which up till quite recently was the greatest depth recorded in the oceans. Should the weather remain favourable other soundings will be made in this little-known "Deep." Besides adding important facts to our know-

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ledge of the bathymetrical survey of the Atlantic Ocean, this will enable us to test the capabilities of our deep-sea gear to its fullest extent, thus bettering our researches in the south. As fast a passage as is possible will then be made to the Falkland Islands, where a few days will be spent taking a final supply of coal on board as well as fresh mutton, beef, and other provisions. Throughout this part of the voyage as many observations and collections as possible will be made, without stopping the ship, in meteorology, in physical observations of the surface of the ocean, in planktonic and nektonic collections.

After leaving the Falkland Islands an east-south-east course will be steered until longitude 30° W. is reached in the vicinity of the Sandwich Group; this point should be reached on about the 1st of November 1901. It is possible that a line of soundings running southward will be taken at this time along the meridian of 30° W., which will be of extreme interest in relation to Ross's sounding of 4000 fathoms, no bottom in 68° 34′ S. and 12° 49′ W., and to the deep soundings taken by the *Valdivia* between Bouvet Island and Enderby Land. During this first season, however, the primary piece of work will be to push southward in this longitude to a high latitude and establish a wintering-station. It is hoped that a latitude of 80° S. might be reached for this station, or if the coast-line of the Antarctic continent be not met within that latitude, the ship will push southward, as far as the ice allows, till land is reached, but no unnecessary sacrifice of the ship or of scientific work and records will be made, however, in attempting to reach the South Pole, but failing to find land south, a course will be steered eastward to strike the southern continuation of Graham's Land, where the station will be set up.

After the house has been built, provisions for three years having been landed, as well as all the instruments and implements necessary for scientific work, and the staff of seven men, the ship will hastily retire before winter sets in, to gain the open sea and the Falkland Islands. Here officers, ship's naturalist, and crew will rest and recruit for a week or possibly two in order to continue with vigour the work that will have to be done during the winter, before returning to relieve the wintering party in the coming spring, viz., November 1902. I regard it as highly important that the ship should not winter in the ice, if it is at all possible to avoid it; by so doing she becomes a hulk to all intents and purposes, whereas if she is free she can be carrying on excellent oceanographical researches in the open sea in unknown and moderately high southern latitudes. Soundings will be made for instance in radiating lines all round South Georgia. South Georgia itself, the Sandwich Group, and other islands will be visited, and all manner of deep sea and island collections and observations made. At the end of the winter the ship will call at Buenos Ayres or Port Stanley, and after being overhauled, provisions and coal will be taken on board. These will include another two years' provisions in addition to the three years' provisions landed during the previous season, thus making the winterers perfectly secure for at least four more years should the ship find it impossible to reach them again during the next or following two years—a circumstance which, though possible, is scarcely

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probable, yet must be provided for. There will no doubt also be a plentiful supply of food near the station, seals, penguins, and other birds forming excellent and nutritive food, as well as fuel.

After the arrival of the ship in the second summer she will be used, as long as the season will permit, to explore in the vicinity of the station. We shall sound, dredge, trawl, and tow-net, and carry on marine physical observations, and visit land that it was impossible to reach by sledge during the previous early spring. Again the ship will not be allowed to winter, if it can possibly be avoided, but will return northward to go on with observations similar to those of the previous winter. Those at the station will once more set to work with serial station observations in meteorology, magnetism, and terrestrial physics, and local topographical, geological, biological, and other work during the second winter and spring. In the third summer the ship will again push southward, and the whole expedition will return home unless the welcome news come that funds sufficient for a third wintering has been secured. Three winters are more useful than two in securing very much better means, but four consecutive winters of life with the long dark polar night I consider undesirable and unnecessary. The work done during a fourth winter would, I believe, not be of sufficiently good quality to justify the attempt.

The house, which will be of Russian construction, will be built of logs; it must necessarily be small, because of the difficulties of transport during so long a voyage. There will be double windows and doors all properly secured against cold. There will be one main compartment, and two or three smaller ones. Besides this there will be magnetical and meteorological observatories, and storehouses for provisions and gear, and properly sheltered accommodation for forty dogs. The station will be lighted by electricity, the energy being supplied with a petroleum engine.

On the homeward voyage of the expedition, the vessel will complete as far as possible the accurate survey of the east coast of Graham's Land, the bathymetrical survey work between that coast and about 30° W. longitude.

The great value of such an expedition at the present time is that it will not only secure a number of highly interesting and important observations in the Antarctic, but that these observations will enhance, and will be enhanced by, the observations being carried on at the same time by the German and British Expeditions on the Indian and Pacific sides of the Antarctic. On referring to the diagram it will be seen that the Scottish station completes a triangle of stations round the South Pole, a condition very favourable and indeed almost indispensable for researches in meteorological science. Observations will also be carried out in meteorology and magnetism at Melbourne and New Zealand in connection with the British Expedition, at Kerguelen by the German Expedition, and at Port Stanley or South Georgia in connection with the Scottish Expedition. Thus a very complete series of stations—circumpolar and polar—will be established round and in the Antarctic regions. Should Mr. Otto Nordenskiold succeed in carrying out his plans,

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additional work will be done in the neighbourhood of the South Shetland Islands and Erebus Gulf.

It is my intention to ask the learned societies of Scotland to appoint a committee of advice to which all questions concerning the details of the organisation and scientific work will be submitted. I have been assured by leading members of the councils of most of these Societies that this committee will be constituted as soon as the necessary funds have been secured. The cost of the Expedition, on the lines indicated above, will not exceed £35,000, of which about £10,000 has already been secured. Professor Erich von Drygalski has expressed his pleasure in hearing of a Scottish Antarctic Expedition. "Wishing the best result," he says, "to the endeavours made in this direction, I shall be very happy to allow the German Expedition to co-operate with the planned Scottish one."

The plans have been long considered, and I have consulted with many of the leading authorities in Europe whilst maturing them, notably I may mention His Serene Highness the Prince of Monaco, and Sir John Murray. They are based on the experience I have gained during one summer I spent in the Antarctic regions, and during four summers and one winter in the Arctic regions, and during cruises with the Prince of Monaco in his yacht *Princesse Alice*, and Mr. Andrew Coats in his yacht *Blencathra* (now *Pandora*), doing deep-sea sounding and dredging, as well as on my experience, during more than a year, on the wintry summit of Ben Nevis, where I was in charge of the Observatory.

BOKHARA.

By W. R. Rickmers.

The heart of Asia is easily reached by rail from the shore of the Caspian, and already the personally conducted tourist has triumphantly entered the gates of Bokhara the Noble.

Already in 1896 I had seen much to interest me in the eastern provinces of Bokhara, and in the year before last I decided to revisit them. Accordingly our little caravan left the metropolis on June 27. The first part of our journey lay along the great trade-route to India, and as far as Karshi there is some genuine desert-travel. Gradually, as one passes Baissun, Hissar, Dushambey, the ground rises, and at the provincial capital of Baljuan one encounters in earnest, as it were, the swell from the great ocean of mountains which occupies the centre of the continent. To this province of Baljuan I shall take you to-night. The distance from the railway is 500 miles, and we were three weeks in covering them.

Before starting for the far interior, let us take a glimpse at the capital. First, a view from a housetop over the expanse of flat roofs, from which here and there rise stately mosques and minarets; then a stroll on the market-place, where surges a crowd arrayed in all the hues of the rainbow. Do you wish to step back into the Middle Ages, to everything that was brilliant or sordid in them? do you wish to realise the days

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which followed on each Arabian night, with nothing to mar the truth of the dream?—then go to the holy city, to Bokhara-al-Sherif. Lucky are those who behold this glorious sight before the shop-signs of the European trader have become too numerous.

Dr. von Krafft, the geologist, was of our party; I need not praise him here, for his recent appointment to the Geological Survey of India is in itself, I think, a sufficient appreciation from a competent quarter; then there was Makandaroff, my Caucasian interpreter, not endowed with great courage, but with a fertile brain, a stock of languages, and great volubility of speech — all qualities which generally prove the better part of valour, out East; and an officer of his Royal Highness the Ameer, who accompanied us as guide, his duty being to see that every-

The Governor's Castle, Baljuan.

where fitting accommodation was provided for ourselves and our horses. His presence with us was tantamount to a letter of safe-conduct. He also, I daresay, had to keep a fatherly eye on our behaviour.

The native horses are of medium height, and good-tempered. I was not smart enough for the horse-dealers, and had to sell many invalids on the way. A few turned out very well under our treatment, and did good service till the end, when we were very sorry to part with old friends, who would have to go back to blows and scanty fare. They were not only useful, but also provided amusement. Many a time did we interrupt the march and play at cowboys in trying to catch a runaway. The roads are rough tracks, though in the plains one could drive along them at a pinch, provided the vehicle has a good constitution. Bridges are few and far between, and often the Ameer's highway is deflected for a

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considerable distance owing to their scarcity. Most of them, constructed on a primitive form of the cantilever principle, are unable to resist the onrush of the spring floods, and have to be built anew each year.

Our quarters were uniformly the best the place offered—either the modest mud-hut of a village squire or the spacious residence of the governor of a province. In the deliciously cool nights of summer we always slept outside, the dryness of the atmosphere doing away with all danger of a chill. Our guide always sent a messenger in advance to announce our arrival. On approaching our destination we were usually met by a crowd of gaily dressed officials, whose white turbans, brilliant garments, and richly caparisoned steeds recalled some scene from the writings of an Eastern poet. Saluting us with true Oriental dignity, they

The Gallows.

escorted us to their houses, where we found ample preparations made for our reception. Where Russians often pass, tables and chairs are provided, but being of native manufacture, their proportions are awkward and their equilibrium is unstable. The table or carpet was covered with a profusion of fruits and sweets of every variety; soups, fowl, mutton, and rice forming the more substantial part of the repast. Certain kinds of sweets—the cheapest Moscow can produce—are only for show, as nobody will eat them, and they presented a venerable appearance. They seem to be considered an indispensable table-decoration. When the next stage was a lonely outpost, they were sent ahead by an express rider, in order that they might figure on the humble piece of felt on which the local authorities served the meals. Subsequently they were returned to the treasury at headquarters. I do not wish to belittle

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the good intentions of our hosts: they went so far as to carry chairs on horseback to out-of-the-way places, though we were quite content to squat on the floor. I take it for granted that the East has good bazaar jokes about us Occidentals, and thus we are quits.

Karatagh, which is situated at the foot of the Hasrat Sultan mountains, is the summer residence of the Kush-Begi of Hissar, the most important statesman after the prime minister. He is the governor of the entire eastern half of the Ameer's dominions, and invested with great privileges, having power over life and death. During the winter he lives at the ancient capital of Hissar. At the appearance of the warm season, when malaria and mosquitos render the place

A side valley of the Yakh Su.

almost uninhabitable, he migrates with his goods and chattels and a great part of the population to Karatagh. This biennial exodus almost clears the town, for everybody, from the highest official down to the meanest prisoner in the jail, follows his master. Not only does the Kush-Begi move all his valuables, even the lumbering cannon, of which he can muster three specimens, are dragged in the train of the hundreds of camels. Many of the animals groan under the weight of the hard cash, while others have the lighter burdens assigned them of carrying the numerous inmates of the harem.

As the prophet has strictly forbidden the drinking of wine, I was astonished to find among the furniture a quantity of empty champagne bottles; but the contents thereof were known to the law-abiding Mohammedan under the name of French lemonade.

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From Karatagh we had each day to struggle over some rugged mountain pass, and we successively crossed the Kafirnigan, the Vaksh, and the Kisil Su rivers. Between Norak, famous for its salt-mines, and Tut-Kaul, the Vaksh runs through an extremely narrow valley. Here the path skirts the rim of precipices over which a single false step would suffice to fling horse and rider into the turbulent waters below. At the spot where this river, equal in volume to the Thames, is pent into a rocky channel eight feet wide, the native engineers have seen their opportunity. A few beams are sufficient to span the cleft, while a thick hedge of interwoven branches screens the giddy depths from the traveller's eyes. The gate on the bridge marks the frontier between the provinces of Hissar and

The Russian colony in winter.

Baljuan. In ancient times, when constant wars were waged between the minor states, many a border raid must have been frustrated at this point.

Baljuan, the capital of the province of the same name, was the last town of any pretensions which we passed before we arrived at our destination. Here, in contrast to the flat mud housetops prevailing in other parts, we have sloping roofs thatched with reeds. The ground is entirely composed of loess, a kind of clay. This formation dominates the landscape as far as the high alpine regions. Its varied aspects, deep chasms and steep banks, constitute a characteristic scenery of their own. A sea of slippery yellow mud in rain, the source of volumes of impalpable dust in dry weather, it makes itself but too familiar with the clothing and the eyes of the traveller.

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The palace of the governor is picturesquely situated on the high banks of the Kisil Su. On market-days the population overflows into the dry bed of the river, and one may see a crowd of horsemen playing their favourite game. A goat is killed and flung among them; they then try to carry it away to a certain goal. Exciting scrimmages occur, and one continually sees feats of strength and skill, such as the picking up in full gallop of the heavy animal. The natives are not scientific riders, but sit tight all the same; they madly career over the boulders, pulling their poor brutes suddenly round with a savage jerk at the rough bit. Thus the horses soon develop a fault of some kind, and

A valley in the conglomerates.

it is extremely difficult to find a moderately perfect charger, though there are many fine-looking animals and even a few famous breeds. Rich officials only want a plump, prancing steed with fancy marks or an odd freak of build or colouring. They do not give so much for intrinsic qualities, as they can always change *en route*. As riders they have great patience and staying-power, often doing 500 miles in nine or ten days. Some of the Government messengers will do 200 miles within the forty-eight hours.

The inhabitants of the country are a very quiet people. Their chief characteristic is a dignified slowness coupled with graceful bearing.

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Loud laughing or wild gesticulations one hardly ever sees, and only once have I witnessed a fight between two men. A Bokhariot is never in a hurry, and enforced punctuality would tax too heavily his conceptions of time. Of bold assaults there is no fear as long as a single Cossack is to be found within a hundred miles; but they like to play nasty little tricks whereof the perpetrators are difficult to find. Robberies are generally committed by Afghans or Turkomans.

The laws of the country are very strict, and therefore you find outside every village a structure, which looks as if it had been erected for football, but which is a goal at which many a career has ended—the gallows. It must be said that these people have

A Barrier.

solved the problem of painless hanging, for the criminal's throat is cut before he is made to swing. Russia has taken steps to prevent draconian justice, and many of these instruments evidently suffer from neglect.

Let us now turn to less gloomy impressions—to a haven of rest, the governor's garden at Baljuan, with our apartments. The contrast between this shady grove and the dreary dusty steppe is heavenly. Trees such as these are rare, the country as a whole being remarkably bare of the more stately representatives of the vegetable kingdom. The natives with their primitive tools play havoc with any forest within reach, ruthlessly destroying as many as two or three trunks in the attempt to obtain a single plank. The trees in the gardens or courtyards are generally planes.

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Continuing the journey, we left Baljuan and crossed a watershed into the valley of the Yakh Su. We bade farewell to the regions of sand and steppe and loess, and entered the sub-alpine level. From the summit of the pass between Khovalin and Saripul we had our first glimpse of that wonderful mountain system henceforth to be known as the Conglomerates of East Bokhara. This district was first visited by Regel, but other travellers have neglected it and nobody has hitherto described its peculiarities. It constitutes a curiosity of the earth's surface, being a mixture of the Bad Lands, the Dolomites, and the Garden of the Gods.

The remarkable geological feature of the Conglomerates covers an

Scenery on the Oxus.

area of 800 square miles, disposed in a long strip. Ascending the Yakh Su river we established our headquarters at one of its tributaries—the Safet Darya or White river.

Conglomerate is, as its name implies, a mixture. A most heterogeneous selection of crystalline, volcanic, and stratified rocks, being the boulders and pebbles from the mountains of older formations, were deposited on the bottom of a tertiary ocean, and so thick was this layer that new mountains could be carved out of it. Its artificial analogy is the concrete used for building, of which there are two kinds, the soft or collapsible and the solid; it is the same in nature. In the case of East Bokhara the conglomerate is very hard indeed, the fragments being cemented together by silicates. On this material running water has been and still is the chisel for Nature's sculpture. You will

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observe perfectly level bands across the face of the mountain, showing that the layers have not been disturbed by upheavals. If we go a few miles farther north to the Yakh Su valley, we find the strata tilted. They have been broken into huge slabs and almost set on end. Their upper edges, seen sideways, look like sharp points.

The Russian gold-mining camp of Safet Darya is 6000 feet above sea level. The precious metal has been obtained from this region for centuries, as is shown by old heaps of tailings. Legend associates these old workings with Chingiz Khan, whose name is as proverbial in Central Asia as that of Queen Tamar in the Caucasus. The apparatus for treating the gravel is very simple, the gold dust being caught by strips of felt. From eight to twenty-four grains of gold may be extracted from a ton of gravel. If it were not for the money-lenders and the official blood-suckers, the population might attain a flourishing condition. Russia is, however, changing this state of affairs.

During our stay at the colony we made frequent excursions to the surrounding mountains and valleys. The scenery is wild and weird to the last degree. An intense solitude pervades the valleys; hardly a living creature is to be seen. Serrated ridges and gaunt pinnacles stand out black against the sky. In the more secluded valleys meagre woods manage to exist, to the great delight of the lover of nature. The pine is represented by the thuya, which thrives on scanty soil, and is satisfied with a precarious foothold on the brow of precipices, safe from the ravages of man.

I shall now say a few words concerning an interesting phenomenon, which has not yet, I believe, been described in the literature of physical geography. There are several barriers reaching across one of the valleys, and dividing it into sections. The river passes through a narrow cleft or cañon on one side. As lengthy explanations are out of place here, an outline of my theory must suffice. The valley was choked by débris—earth and gravel—coming from one direction. Here and there a rock ridge, which protruded too far, was buried in the softer material, and the river, raised into a higher bed, cut through the solid conglomerate, thus gradually regaining the original level.

We wished to reach the summit of a very prominent and jagged peak in the wildest portion of the conglomerates. It was, however, no easy matter to find a way, for the fortress is defended by a puzzling labyrinth of trenches, walls, and buttresses. From no point of vantage could we get a clear insight into the plan of the stronghold. What looks compact from afar dissolves into independent ridges and chasms as one approaches. After two abortive guesses, we succeeded in the third attempt. First this plateau was reached, and then, after a descent into the intervening depression, the mountain itself. The rock-work was never very difficult, but often exciting. Here one can have the sensation of which one frequently reads, but which is rarely literally true, that of going along a ledge similar to a shelf in a cupboard—that is to say, with a perpendicular wall above and below. As the material is exceedingly firm, the projecting stones offer excellent handholds, and steep walls can be surmounted with remarkable ease. On these ledges

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Barrier at the junction of the Dandushka and the Safet Darya.

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one finds steep inclines of very hard earth, like those on the moraines of glaciers, and a secure footing can only be obtained by cutting steps.

The top of Hazrat Ishan is partly covered with snow, which forms a glacier, the only one in the conglomerate. The name of the mountain, Hazrat Ishan, is derived from a Mohammedan saint, who is said to have converted to Islam this part of the country. A minor saint, viz. a mollah or priest, from one of the villages, is buried on the top. A heap of stones and the usual pole hung with rags indicate the spot. Native officials in gorgeous raiment may now and then be seen wending their way to the summit, bent on a pilgrimage to the holy grave. Owing to the advantageous position of Hazrat Ishan the view is very grand. Not a single snow-mountain is seen towards the

In the plains of the Oxus.

west, but eastwards there is nothing but an immense ocean of ice and snow, sweeping round in a huge curve from north to south.

I only observed two wild mammals, marmots and a species of mountain-sheep, probably arkhal. I once stalked and wounded one of the latter, but it got away in the inextricable maze of gullies and ledges. As the natives use for pasture every patch of grass to which they can drive their sheep, the game frequents only the loneliest parts. There is, however, one place safe from domesticated cattle, the plateau near Kutch-Manor, which is a grassy plain of considerable dimensions. When Dr. von Krafft and myself reached the top of Kutch-Manor we also passed over this secluded paradise, which even the native hunters have never been able to enter. Towards all sides steep rocks descend from it; and the marmots, which stare till one might almost seize them, and

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the broad tracks traced out by the hoofs of mountain sheep, show that here the wild animals feel secure amid an abundance reserved for their exclusive use. Birds of prey are plentiful. In the rocks just above our house a pair of vultures had their sleeping-place, and we could see them going to bed every evening at six o'clock.

Before our return we paid a short visit to the plains of the Oxus. Dr. Krafft was called home, so there were only my wife and myself. The villages become more and more well-to-do as one approaches the low lands. We pushed on as far as Parkhar, in the beautiful and idyllic plain of the Sayat river, a branch of the Oxus. Here we have a pleasing combination of pasture, park, swamp, and impenetrable jungle. Every pool is the abode of numerous water-fowl, and the reeds swarm with pheasants. The tracks of the tiger are frequently seen, but I waited four consecutive nights without getting a shot: the decoy goat always refused to bleat.

Returning to Safet Darya we found a snowstorm raging in the Yakh Su valley, and the Russian Colony buried in snow. These signs of approaching winter warned us not to delay our start. On 4th November, therefore, we left, following our previous route as far as Akrabat. Here we struck northwards, and travelled by way of Shahr-i-ziabs and Kitab to Samarkand, thus bringing to a close a most enjoyable and instructive journey.

RIVER TERMINOLOGY.

By RALPH RICHARDSON, F.R.S.E., F.S.A.Scot., Hon. Secy. R.S.G.S.

ONE of the first things which attracted and demanded the attention of Man must have been his supply of Water. Sources, streams, rivers must often have been the object of his search, the subject of his study, and they must have determined and defended his habitation, for without them he could not exist.

We may assume, then, that these most necessary objects acquired an importance from the earliest times, and we may reasonably look for the names bestowed upon them by primitive man being handed down to us in ever-changing forms from one generation to another.

As a proof of this, let us, by way of introduction, glance at the origin of the word *Water* itself. Strange as it may appear, it is derived from "the first vocal sound uttered by infants, the first audible sign of human life,"[1] and appropriately forming the first letter in the alphabet. As this vocal sound indicated the first sign of life in animated beings, it became also the first sign of aqueous life in the world which man inhabited. In other words, prehistoric man employed the vocal sound *A* to indicate "a source."

This vocal sound *A* may seem to many a singular one to apply to a

[1] Letter A in *Dictionary of the English Language*. By Charles Richardson, LL.D. New edition (1856).

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"source," but it is to this day widely applied to much more than a source, viz., to a "river." The term *Aa* is the name of about forty rivers in Northern, Western, and Central Europe. There are in Switzerland alone no fewer than five rivers each bearing the simple name *Aa*, bestowed upon rivers generally by primitive man. There are also rivers of that name in Germany, France, Russia, and Holland, whilst we have our own *Ae* in Dumfriesshire and *Awe* in Argyllshire.

It is this term *A*, signifying "a source," which is the root term in our English word "water." Whilst the letter *A* signified water in its simplest form, *Aa* signified flowing water, and as we have seen, it is still employed in that primitive sense in the case of many rivers over a wide geographical area.

Our word "water" comes from the Gothic *wato* and Anglo-Saxon *wæter*, but the original *A*, signifying "a source," is its root term, as it is also that of the Sanskrit *Ap*, the Gothic *Af*, the Persian *Ab*, the old German *Aha*, the Latin *Aqua*, and the Welsh *Aw*, from which "expressive root are derived all words, in Welsh, implying fluidity or the motion or action of fluids."[1]

Looking at River terminology in the light of representing an element essential to the life and wellbeing of man, it should not surprise us if we occasionally find instances of terms of rivers which we might classify as having a family resemblance.

As mankind spread over the globe, they would naturally bear with them terms for streams and rivers which they would apply as they discovered new rivers and streams in the course of their wanderings. These terms would necessarily greatly change with the lapse of centuries, just as the original word for "water," known to primitive man as simply *A*, has come down to us in the strangely enlarged and elaborated form "water."

But, just as from one letter which the word "water" contains, we can trace its origin back to the remotest antiquity, so possibly we may be able to classify certain river terms by recognising in their terminology some evidence of a common ancestor.

I shall endeavour in the following article to make such a classification, based entirely on philological and comparative geographical grounds, and I shall submit a few groups of rivers having a terminology which, I venture to think, may, on these grounds, be classified together.

The *first* series of river terms which seem to me to be capable of such classification comprises terms which are no doubt derived from a common ancestral form signifying "water," "a source," or "a stream," a form which, although it has now lost almost all resemblance to the *A* of primitive man, is yet as certainly derived from it.

Whilst keeping this essential root term in view, I have formed the first series of river terms by classifying those prefixed by the dentals D, T, and Th, all interchangeable according to Grimm's Law. I do not know the origin of this dental prefix of so many river terms, but it is interesting, is deserving of study, and is a peculiarity which furnishes at least a reasonable ground of classification.

[1] Dr. Pughe's *Welsh Dictionary*, edited by Mr. Pryce, 3rd edition (1866).

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As examples of the passage of a non-dental into a dental form I may instance the Anglo-Saxon *ēa*, signifying a river, passing into *strēam* (also an Anglo-Saxon term), and the river term *Avon* (from the Gaelic *av* and Welsh *aw*, signifying "water"), passing into the river terms *Devon*, *Taw*, *Tavy*, *Devern*, *Treveryn*, etc.

As a general illustration of how dental prefixes came into use in terms containing the primitive *A*, and therefore expressive of "a source" or "water," I give the following table, it being remembered that the primitive *A* may, by transmutation, be represented by another vowel:—

A = Primitive term for "water" or "a source."
Å = Swedish term for "a river."
Aa = River term in common use throughout Europe.
Ae, Awe, Aare, Aray, Urr, Ure = River terms in Scotland, Switzerland, and England.
Ēa, Īe, Ē = Anglo-Saxon terms for "a river" or "a stream."
Ab, Atte or *Atle* = Persian and Mexican (Indian) terms for "water."
Abh, Aff, Avie, Aive, Av = Gaelic terms for "water."
Abhuinn, Amhuinn, Avon, Allt, Ault, Ald, Auld = Gaelic terms for "a river" or a "stream."
Aw, Gwy, Dyfr, Dwfr, Dwr = Welsh terms for "water" or "a stream."
Dobur, Tobar, Tiobart, Tiobar = Gaelic for "a source," "a well," "a stream."
Donau (Danube), *Darya, Dee, Dart, Tay, Tiber* = Austrian, Persian, English, Scottish, and Roman river terms.

In the following sub-classification of the FIRST or dental series of river terms into nine groups, I have depended chiefly on phonetic and orthographical similarities, my desire being to bring together for comparison those river terms the similarity of which most readily strikes the eye.

The *first group* of the first or dental series comprises the following river terms, in which the ancestral *A* or an interchangeable vowel are visible:—

Tay, Perthshire.	Thame, Bucks.
Tagus, Spain (*Spanish*, el Tajo).	Thames, Middlesex.
Tavy, Devon.	Temes, Hungary.
Taw, ,,	Teme, North Wales.
Tamar, ,,	Daer, Lanarkshire.
Dane, Cheshire.	Darent, Kent.

In the *second group* of this series the river terms have prominently the vocal sound *ee* contained in the Anglo-Saxon *ēa*, "a river or stream":—

Dee, Cheshire.	Eden, Roxburghshire.
,, Aberdeenshire.	Tees, Durham.
,, Kirkcudbrightshire.	Teirw, North Wales.
,, County Louth.	Tweed, Roxburghshire.
Dean, Forfarshire.	Teith, Perthshire.
Tean, Staffordshire.[1]	Teify, South Wales.
Eden, Cumberland.	Teviot, Roxburghshire.
,, Fife.	Tiete, Brazil.

[1] Cf. Teign, Devon; Tyne, Northumberland and Midlothian.

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In the *third group* of this series the vocal sound is a short *e*:—

Tet, South France.
Thet, Norfolk,
Test, Hants.
Ter, Spain.
Terek, Caucasia.
Tern,[1] Shropshire.
Devern,[2] Aberdeenshire.
Devon, Clackmannan.
Derwent, Cumberland.
„ Derbyshire.
„ Northumberland.
„ Yorkshire.

In the *fourth group* of the dental series I place the following river terms:—

Ticino, Switzerland.
Till, Northumberland.
Tilt, Perthshire.
Timok, Servia.
Tinto, Spain.
Tiberis, Tiber, or Tibris (English *Tiber*; Ital. *Tevere*), Italy.

In the *fifth group* of this series are river terms the prominent vocal sound in which is *Don* or its allied forms:—

Don, Russia.
„ France.
„ Aberdeenshire.
„ Yorkshire.
Donau,[3] or Danube, Austria.
Doon, Ayrshire.
Donetz, Russia.
Dneiper, Russia.
Dneister, Austria.
Tone, Somerset.
Tom, Siberia.
Tummel, Perthshire.
Dommel, Netherlands.
Dombovitza, Roumania.

In the *sixth group* of the dental series the vocal sound *u* (long) is prominent, as in the Welsh *dwr* (pron. *dūr*), "water" or "a stream":—

Dour, Fifeshire, and Kent.
Douro, Portugal.
Adour, France.
Adore, „
Stour: the name of 5 English rivers.
Durance, France.
Douze, France.
Tula, Mongolia.
Tura, West Siberia.
Twreh, North Wales.

In the *seventh group* of the dental series the vocal sound is prefixed by *Dr*, *Tr*, or *St*:—

Drave, Hungary.
Trave, North Germany.
Dryfe, Dumfriesshire.
Drôme, France.
Dronne, „
Drin, Albania.
Drina, Bosnia.
Traun, Austria.
Trent,[4] Staffordshire.
„ Derbyshire.
Treveryn, North Wales.
Tronto, Italy.
Stiffkey, Norfolk.
Stolpe, Prussia.
Stör, Germany.
Stour, Suffolk.
„ Kent.
„ Oxford.
„ Somerset.
„ Worcester.
Stort, Essex.
Strule, County Tyrone.
Struma, Bulgaria.
Stry, Galicia.
Styr, „

[1] Cf. Erne, County Fermanagh; Earn, Perthshire.
[2] Cf. Severn, Wales.
[3] *Hungarian*, Duna; *Slavonic*, Dunai.
[4] Cf. Tern, Devern, Severn, Treveryn, Derwent, Trent.
„ North Yorkshire.

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By means of these seven groups I have attempted to show that there is a large class of river terms which seem philologically allied, although often geographically far apart, a good specimen of this simultaneous propinquity and ubiquity being the term *Don*, which is applied to a river in Russia, to another in France, to a third in Aberdeenshire, and to a fourth in Yorkshire. It is impossible to believe that this frequent occurrence of *Don* as a river term is a purely accidental circumstance.

In the SECOND series of river terms we may perhaps detect the sibilant of the Sanskrit *sru*, signifying "to flow," the Gothic *aquos*, and the Gaelic *uisge*, both signifying "water," the German term for which, *wasser*, is likewise sibilant. I may add, as illustrative of the mutation of terms, that the Latin *aquae*, signifying "medicinal springs," became transformed in modern French, in more than one instance, into *Aix* (pron. *Ex*) as in Aix-les-Bains, etc. The following is a group of sibilant river terms:—

Seine, France.
Senne, Belgium.
Severn, Wales.
„ North Yorkshire.
Saone, France.
Somme, France.
Seim, Russia.
Save, France.
„ Hungary.
Axe, Somerset.
„ Dorset.
Exe, Devonshire.
Esk, Forfarshire.
„ Dumfriesshire.
„ Midlothian.
„ Yorkshire.
Usk, Monmouthshire.
Usa, Russia.
Spean, Inverness-shire.[1]
Spey,[1] „
Spree, Prussia.

In the THIRD series of river terms the particle *ro* or *ri* predominates, and may be derived from the same root as the Greek ῥέειν, signifying "to flow," the other derivative forms being the Latin *rivus*, the old French *ru* and Spanish *rio*, all signifying "a river." As examples I give:—

Rhine, Germany.
Rhin, North Wales.
Rhone, France.
Rion, Russia.
Garonne, France.
Dronne, „
Ebro, Spain.
Roer, Germany.

Rhine and *Rhone* are British, as well as Continental aquatic terms. Lord Macaulay in his *History* (Chap. v.) remarks that in 1685 "when Monmouth looked upon Sedgemoor, it had been partially reclaimed by art, and was intersected by many deep and wide trenches which in that country (Somerset) are called *rhines*." Monmouth's army had to cross "three broad rhines filled with water and soft mud" named respectively the Black Ditch, the Langmoor Rhine, and the Bussex Rhine, the last of which proved disastrous. In his *Life of Marlborough* (Chap. I.) Sir Archibald Alison refers to the last as "the stream called the Bressex Rhine."

[1] Cf. Spa or Spaw.

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These rhines were contiguous to villages of which, says Macaulay, "the names seem to indicate that they once were surrounded by waves," viz., Zoyland, Middlezoy, etc. Now, Zeeland is the Dutch province at the principal mouth of the German Rhine, and is divided by all England from Somerset, yet both it and Zoyland are the same term.

With regard to *Rone* or *Rhone*, it is defined in Jamieson's *Scottish Dictionary* as "a spout for carrying rain-water from the roof," and is derived by him from the Swedish *raenna*, having the same meaning, and the modern Saxon *ronne*, a canal.

Finally, in order to explain my FOURTH and concluding series of river terms, I return to the statement with which this article opened, viz., that the earliest term for "a source" or "water" was simply *A*, and for "flowing water" *Aa*. Based upon this well-established proposition, I present the following list of river terms as probably derived from the term used by primitive man for all rivers, or for water in any form:—

Aa: about forty rivers in Europe bear this name.
Ae, Dumfriesshire.
Awe, Argyllshire.
Aare,[1] Switzerland.
Ayr, Ayrshire.
Aire, Yorkshire.
Aras, Armenia.
Aray, Argyllshire.
Aran, France.
Aragon, Spain.
Araglin, County Cork.
Arrow, Radnorshire.
„ Worcestershire.
„ County Sligo.
Avon, Wales.
„ Devonshire.
„ Monmouthshire.
„ Wiltshire.
„ Gloucestershire.
„ Banffshire.
„ Clackmannan.
Avon, Lanarkshire.
Adige, Italy.
Adour, France.
Adore, „
Adda, Italy.
Alde, Suffolk.
Alt, Lancashire.
Alt or Aluta, Hungary.
Almond, Perthshire.
„ Midlothian.
Amoor, Siberia.
Alma, Crimea.
Almo, Italy.
Ale, Roxburghshire.
„ Berwickshire.
Aln, Northumberland.
Alne, Warwickshire.
Alyn, North Wales,
Alwen, „
Alwyn, Roxburghshire.
Allan, „
„ Stirlingshire.
Allen, Cornwall.
„ Dorset.
„ Wales.
„ Northumberland.

I may add that the term *Almond*, for the rivers of that name, is a corruption of the Gaelic *Amhuinn* or *Avon*, derived of course from the primitive *A*, signifying "water." This *A* became the Latin *Aqua* and Spanish *Agua*, and hence we find the following Spanish river terms (the preliminary *A* being excised):—Guadalaviar, Guadalete, Guadalimar, Guadalquivir, Guadiana, Guadiaro, Guadiato, and we also observe the *agua* in Tagus, which is akin to the Scottish *Tay*.

[1] Cf. Urr, Kirkcudbright; Ure, Yorkshire.

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In attempting to classify certain rivers on purely philological grounds and with the aid of comparative geography, I regret to have differed from the theories advanced by some well-known and justly celebrated philologists.

Thus, Professor Rhys derives the river term *Dee* from the Sanskrit *devi*, Welsh *dwyf* or *dwy*, and Irish *dé*, all signifying "a goddess," to whom, he is of opinion, the river was dedicated,[1] a theory which assumes that the name of "goddess" was bestowed on rivers found so widely apart as Cheshire, Aberdeenshire, Kirkcudbright, and Ireland. Full of Pantheistic enthusiasm, Professor Rhys exclaims:—"Every locality had its divinity, and the rivers were specially identified with certain divine beings: witness the streams that still bear the name of Dee, and kindred ones." Our poets especially invested the Cheshire and Welsh Dee with supernatural attributes. Milton referred to it as a "wizard stream," whilst Spenser apostrophised it as the

> "Dee which Britons long ygone
> Did call divine, that doth by Chester tend."

That the Welsh river term *Dee* should be derived from a word signifying "a goddess" is the more remarkable, as there are Welsh words signifying "water," which seem to have a prior claim. The Welsh terms *Dwfr*, *dyfroedd*, *deifr*, *dyfr*, or *dwr* signify "water," and are akin to the Armorican *dour*, the Old Gaelic *dobhar*,[2] and the Greek "Τδωρ (hydōr), all signifying "water." The town of *Dover* stands at the mouth of the rivulet *Dour*. Dover was the *Dwffyrrha* of the ancient Britons, the *Dubrae* of the Romans, and the *Dofra* or *Dofris* of the Anglo-Saxons, —all terms derived from the original *Dour* = water, which is represented phonetically better by the French *Douvres* than the English *Dover*. The Kent *Dour* is synonymous with the Portuguese *Douro* and the French *Adour* and *Adore*, the two last containing both the primitive *A* and the Celtic *dour*.

Turning to another well-known river term, we find that the late Professor Veitch derived the term *Tweed* from the Cymric *Tywi*, signifying "a boundary,"[3] and stated that he preferred this etymology to that of Colonel Robertson, who derived it from the Gaelic *Tuath-aid*, signifying "the river flowing to the north side."[4] The latter also derived the river term *Dee* or Deva from two ancient Gaelic words, *Da-abh*, signifying "the double stream," that is, a river formed by two streams joining each other, adding:—"This old name *Deva* very strongly confirms the contracted use of the Gaelic word *Da* along with *eva*, that being the corrupted part of the word *avon* (properly ab*h*uinn) for 'a river.'"

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[1] *Hibbert Lectures* 1886, p. 117. *Lectures on Welsh Philology* (1879), p. 307. *Celtic Britain* (1884), p. 67. The Rev. James B. Johnston takes all the divinity out of the river term *Dee* by deriving it from the Gaelic *Dèabhadh*, signifying "draining."—*Place-Names of Scotland* (1892), p. 86.

[2] Hence *dobhran*, an otter.

[3] *Letter to the Author, and "Border History and Poetry"* (1878), p. 50.

[4] *The Gaelic Topography of Scotland and what it Proves* (1869).

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Whilst the influence of his study of Celtic paganism may perhaps be detected in Professor Rhys's derivation of the term *Dee* from "a goddess," the fact that the Tweed separates two kingdoms may account for Professor Veitch translating it "a boundary," and Colonel Robertson "the river flowing to the north side." The proximity of the Don and Dee at Aberdeen perhaps makes the latter's derivation of *Dee* recognisable.

Again, Professor Veitch derived the river term *Teviot* from the Cymric *Teifi*, which, he said, signified "the spreading stream," although this is not an attribute peculiar to, or particularly characteristic of, the Teviot. Colonel Robertson objects to Cymric terms being employed to decipher Scottish river terms, and derives *Teviot* from the Gaelic words *Taobh-aite*, signifying "the river flowing at the side, that is, of the ridge or hill next it," which is not a very luminous description.

According to the theory which I have advanced in this article, terms such as *Dee*, *Tweed*, and *Teviot* belong to a large class of river terms found over a wide geographical area, and are all capable of being traced back to the root term *a*, signifying "water" or "a source," used by primitive man. That this vocal sound *a* may change into *ee* is proved by *e.g.* the Latin *canis* becoming the French *chien*, *pax* becoming the English *peace*, etc. In the leading Anglo-Saxon term for a "river" or "stream," *ēa*, we find a blending of the original *a* and the long *ē* contained in such dental river terms as *Dee*, *Dean*, *Tees*, *Tean*, *Tweed*, *Teviot*, etc.

Thus taking six British rivers, and tabulating their variations, we may observe how, although their terminology varies in different localities, their common ancestry is apparent:—

Tay.	Aire.	Erne.	Dee.	Tern.	Tean.
Thame.	Aray.	Severn.	Devon.	Trent.	Dean
Thames.	Arrow.	Treveryn.	Devern.	Derwent.	Eden.

It appears to me that, except under exceptional circumstances, the origin of river terms must be looked for neither in religious nor political spheres. It must be based solely on philological and comparative geographical grounds; and if we recognise over a wide geographical area a number of river terms having a marked resemblance, then I submit we may conclude that these terms contain some primitive root term for "water," "a source," or "a stream."

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meetings held in May.

On the 8th May, at Dundee, Mr. W. S. Bruce delivered a lecture entitled "Spitzbergen: Voyages with H.S.H. The Prince of Monaco." He also gave a brief account of his proposed Scottish Antarctic Expedition. Professor D'Arcy W. Thompson presided.

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On the 10th May, Mr. Robert Smith, B.Sc., Assistant Professor of Botany, University College, Dundee, exhibited several sheets of his Botanical Survey of Scotland. Mr. Smith having explained the nature of the work he had undertaken, a discussion ensued in which Mr. Peach of the Geological Survey, and the President of the Society, who occupied the Chair, took part.

On the 23rd May, in Edinburgh, Mr. Arthur H. Sharp read a paper on his journey through Africa in company with Mr. E. S. Grogan. Sir John Murray presided, and a large and interesting collection of curios was exhibited after the lecture. This was the last ordinary meeting of the session.

At the meeting held at Glasgow on the 27th April, Sir John Neilson Cuthbertson, the chairman, made reference to the death of Sir Renny Watson, who had taken an important part in the work of the Glasgow Branch since its formation, and had acted as its convener up to the date of his death. On Sir John's motion a resolution of sympathy with Lady Watson was unanimously passed.

Annual Closing of the Society's Rooms.

The Rooms will be closed for cleaning throughout the month of August.

Antarctic Exploration.

The Secretary has received the following letter :—

May 1st, 1900.

Dear Sir,—I was glad to learn, on my return from the Continent, that the idea of a "Scottish Antarctic Expedition" had really taken root, and from what I have seen in the papers I presume that the Royal Scottish Geographical Society is prepared to receive subscriptions towards the same. I think there is ample scope for the three proposed expeditions, and the fact that they are to be synchronous should enhance the value of each. As a member of the R.S.G.S., I have much pleasure in enclosing a cheque for £10.—I am, yours faithfully,

Jane Hay.

Miss Hay subsequently remitted two additional guineas as donations from Mrs. Hay-Dinwoody and Mr. W. Beattie.

GEOGRAPHICAL NOTES.

ASIA.

Baron Toll's Expedition to Sannikov Land.—This will be the most important polar expedition of this summer. Sannikov Land, which is north of the New Siberia Islands, lies in a sea which comprises the least known portion of the polar zone. Baron Toll, who has communicated his plans to *Petermann's Mitteilungen*, says :—"My departure will take place in the middle of June from St. Petersburg, with the *Sarja*, as I have named the Norwegian vessel *Harald Haarfager*, which I have bought. Besides the captain of the ship—Lieut. N. Kolomerzoff—I have two other officers of the Imperial Navy, Lieut. Mathiessen and Lieut. Koltschak ; also an astronomer, F. Seeberg ; a zoologist, A. Biruljä ; and a medical man, who is also a biologist, Dr. H. Walter. The ship's company consists of first and second engineers, three stokers, boatswain, three A.B.'s—all from the navy—also two

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picked huntsmen and a Siberian Cossack, the last-named to serve as interpreter in the case of our meeting with Yakutsk natives, and also to look after the dogs. The plan of the voyage is, shortly, as follows:—In the first summer to traverse the Kara Sea, as far as the eastern portion of the Taimyr Peninsula, where, north of Chatanga-Busen, between 76° and 77° N., the first winter will be spent. In the summer of 1901 we shall go directly north from the New Siberia Islands and seek our winter quarters on Sannikov Land or Bennett Island. In the summer of 1902 we hope to return eastward through the Behring Strait to Vladivostok. I have departed from my original plan of wintering at the mouth of the Lena and sending thence separate portions of the expedition. I am instead sending a portion of my expedition in the coming spring—under K. Vollosovitch, with dog-sledges—from Yana to the New Siberia Islands, in order that they may there carry on the work of Bunge and myself, and establish depots. Lastly, synchronously with my chief expedition, there will be three other meteorological and magnetic stations working in Ustiansk, Russkoi Usti at the mouth of the Indigirka, and Verkhoiansk, during the two years."

Dr. Sven Hedin in Central Asia.—Dr. Sven Hedin has already carried out a considerable part of his most recent journey, the exploration of the Tarim. He arrived at Kashgar on the 1st September 1899, and after a short stay there reached Lailik on the Yarkand-darja, where he purchased a boat in which to pass downstream to Lob-Nor. His passage through the valley began on the 15th September, and he reached Yangi-Köll on the Lob-Nor on the 7th December. The result of this journey is a complete survey of the Yarkand-darja and of the Tarim. Here he fell in with the French explorer Bonin, who was travelling from Tonkin to Siberia. Hedin spent the next week in studying the surroundings of Lob-Nor, and then set out for Tiertie, which he reached on the 12th January of this year. It will be remembered that the survey of the Yarkand-darja was effected by Captain Deasy, who returned to this country last December, after two years of important researches in the Pamirs and the northern Himalayas. In spite of the opposition of the Chinese magistrates, the survey of the river is now complete, except for a small portion which cannot be followed because of the deeply cut banks.—*Petermann's Mitteilungen*, 1900, IV.

Koslow's Expedition.—An account of the routes followed by the members of this expedition is given in the *Iswjestija* of the St. Petersburg Geographical Society. Koslow left Moscow on May 8, 1899, together with Kasnakow. After Ladygin had joined the party in Omsk, the journey was continued through Semipalatinsk and Ust-Kamenogorsk as far as the real starting-point of the expedition's work, Altaiskaja, which was reached on the 11th June. Here they met with Saposhnikow, who came from Marka-Kul and proposed to examine the glacier of Bjelucha. The equipment of the expedition was completed; small excursions were taken in the surrounding districts for the purpose of adding to the collections; a meteorological station was established. On the 14th July Koslow left Altaiskaja at the head of a caravan of 54 camels and 14 horses. The road led up the valley of the Buchtarma to the Ulan-daba pass, the height of which was estimated at 2600 metres. While the chief expedition under Koslow followed the direct route to Kobdo, where it arrived on August 12th, Kasnakow left it at Ulan-daba to follow the more westerly and considerably higher road, and to study the mountain lakes at the sources of the Kobdo. The Lower Kobdo Lake was found to be 16 km. long by 8·5 km. wide, and 17 m. at the deepest point. The highest surface temperature of the water was 20° C., and the corresponding bottom temperature 13·8° C. West of this lake, at a distance of 7·5 km., and united with

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it by a fairly strong river, lies the Upper Kobdo Lake, which is 27 km. in length from E. to W. Its greatest depth was 37 m. Kasnakow and Ladygin thence passed through the Ak-korum pass, which is about 2830 m. high, to the lake of the same name; then through the valley of the Tschegirlaj to its junction with the Deljuin, which from this point bears the name of Bujuntu. Passing down the valley of the Bujuntu they joined the chief expedition at Kobdo on August 16. Koslow's report to the Russian Geographical Society sums up the work of the expedition as follows: "It completed the examination of the Gobi-Altai by two routes, one northern and the other southern. Kasnakow followed the foot of the Altai as far as the meridian of Urga, crossing the mountain from time to time. Ladygin's work was to cross the Gobi by the route from Uljasutaj to Juj-myn-sjan, which had not till then been passed by an European. I myself attempted with the caravan to cross the desert of Gobi to the meridian of Ljan-tschou, in the direction of the Edsin-gol river. Thence through Alaschan to Ganktsu, where we all met." The expedition reaches Sinin in the spring of this year.

AFRICA.

Professor Mackinder's Journey to the Summit of Mount Kenya. — In the *Geographical Journal* of last month Professor Mackinder describes his route and observations. He was accompanied by Mr. C. B. Hausburg, who acted as photographer and camp-master; Mr. E. H. Saunders, a collector; Mr. C. F. Camburn, a taxidermist; César Ollier, an Alpine guide, and Joseph Brocherel, Alpine porter. Having engaged 59 Zanzibaris at Mombasa, the expedition left railhead, then at Nairobi, on July 26. By the addition of a considerable number of Wakikuyu the party was altogether 170 strong. For four days they crossed the treeless Kapoti plains, covered with grass which at that season was burned brown. Three streams, the Ruiru, the Daruku, and the Thika were crossed. There was evidence of lions on the river banks, but game was rare; rhinoceros were the most notable animals met with. From the banks of the Athi to Muluka the country was set thinly with scraggy trees, and the grass became longer and greener. From Muluka the expedition went northward and eastward for five days over a country of successive ridges with deep-cut valleys between them. Rich banana shambas crowned the summits, and irrigated strips of maize wound along the valleys; from a single point in one of the valleys Professor Mackinder counted fourteen separate villages. Crossing the Sagana on August 6th, he entered the Meranga country, which is 30 miles across and is highly cultivated. "The aspect of the country was something never to be forgotten. Here, in the heart of Africa, in a region previously approached by half a dozen white men at most, we traversed square miles of standing maize, neatly divided by slight furrows into rectangular half-acre plots, each, we were told, valued for sale at the price of a goat, and we had to pitch camp in a market-place strewn with corn-cobs, or to march for several miles to the next vacant space." Crossing the Ragati, a tributary of the Sagana, on August 13, the expedition marched for two days through a forest containing many elephants; and on the 15th the Sagana was crossed again, and the camp was pitched on a high site at the outer edge of the forest-curtain of Kenya. This forest zone was passed in one day, and on the next day a camp was established at a height of 10,300 feet, half way between the base of the mountain and the foot of the central peak. Farther up the vegetation of the Alpine zone of the mountain was first seen at Gregory's Höhnel valley. "The unbroken side of the valley, crowned with owl-haunted crags, has a moist peaty soil, in which are set yard-broad hemispherical tufts of wiry grass, each tuft having a moist rotten centre. Well-beaten rat-paths

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ramify in all directions between the tufts, while every here and there are groups of cactus-like giant lobelia, of which some send up tall spikes bearing the flowers. In general appearance very like the lobelia, except as regards the flower, is a species of giant groundsel with silvery leaves; but the greatest curiosity of all is the tree groundsel, with a thick dark trunk 8 or 10 feet high, surmounted by a cactus-like head of green leaves, beneath which is pendant a mass of dead leaves, dry as tinder towards their tips, but moist and rotten near the trunk. Occasionally a tall spike, several feet in height, bearing yellow groundsel flowers and fluffy seeds, stands erect above the leaf-head, or broken and leaning gauntly to one side. In other spots are yellow composites, something like dandelions, but with blossoms sessile on the ground, and bushy everlasting flowers. Beautiful sunbirds with lark-like song fly from lobelia to lobelia." The highest camp was established a mile from the foot of the ice, whence, on the morning of the 30th, Professor Mackinder, with the two Alpine guides, set out on their first attempt to climb the peak. The latter consists of highly crystalline rock, cleft at the summit into two points, the north-western being some 30 or 40 feet higher than the south-eastern, and the two perhaps 1000 feet higher than any other point on the mountain. The first attempt to reach the summit was unsuccessful, and the travellers had to spend the night at the foot of one of the highest peaks, at an elevation of about 16,800 feet. At a later date the two guides again attempted the ascent without success. "At last," says Professor Mackinder, "on September 12, César, Joseph and I left our top camp at noon to make the final attempt to reach the summit. The journey round the peak, made by Hausburg, had clearly shown that no way was practicable up the northern precipice, and we had already failed twice on the southern side, once on rock and once on ice. We now planned a route partly over rock and partly over ice. We followed our first track up and across the Lewis glacier, and up the face of the southern *arête*, near the top of which we spent the night under a Mummery tent. We were up at earliest dawn, and away as soon as the sun rose out of the cloud roof to eastward, thawing our hands so that we could grasp the rocks. A traverse, with steps across the head of the Darwin glacier, brought us to a rocky rib descending from the western corner of Nelion, and up this we crept for a short way. We then decided to cross the glacier which hangs from the Gate of the Mist between the two points, and drains by a couloir into the Darwin glacier below. It proved very steep and intensely hard, so that three hours were consumed in cutting steps on a traverse which we had hoped to make in twenty minutes. A final rock scramble enabled us to set foot on the summit of Batian precisely at noon on September 13." Professor Mackinder secured a plane-table sketch of the upper part of Kenya, together with rock specimens, two route surveys along lines not previously traversed, a series of meteorological and hypsometrical observations, photographs by the ordinary and by the Ives colour processes, collections of mammals, birds, and plants, and a small collection of insects.

ARCTIC.

Professor Kolthof's Arctic Expedition.—The success of Professor A. G. Nathorst's expedition to East Greenland last year has given rise to a further exploration of the Arctic seas especially with a view to the study of zoology. The leader of the expedition is Professor G. Kolthof of Upsala. He left Sweden last month, with the intention of spending a few weeks on Bear Island and in West Spitzbergen, and if possible, of landing on Jan Mayen. Special attention will be given in East Greenland to the musk-ox, and an attempt will be made to bring back living specimens to Sweden, in order to acclimatise them in the northern parts. It is

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hoped that the expedition may make a closer examination of the coast northward from Franz Josef Fjord, where deep fjords, similar to those farther south, are to be expected.—*Petermann's Mitteilungen*, 1900, III.

OCEANS.

Nansen's Expedition during the coming Summer.—Dr. Nansen intends this summer to supplement the oceanographical researches of the *Fram* expedition by an examination of the physical and biological conditions of the northern waters. He writes to *Petermann's Mitteilungen* that the proposed voyage is in no sense a polar expedition, but will be concerned with the Norwegian seas at all depths, between Norway, Iceland, Jan Mayen, and Spitzbergen. "My party and I hope to obtain, with the best and newest instruments, exact determinations of the temperature and specific gravity of the sea-water at all depths. Dr. Hjort will study the plankton conditions at various depths, partly by means of new methods. The leader of the expedition is Dr. J. Hjort, the superintendent of our fishery and marine researches. For this purpose a new steamer is being built, called *Michael Sues*, and will be launched in the middle of April. It is placed at the disposal of Dr. Hjort to carry out, under his direction, our portion of the international marine researches as determined at Stockholm; indeed, this voyage will be the beginning of that work. The results will be valuable to me, as they will probably complete and clear up my researches during the *Fram* expedition."

The Circulation of Water in the North Atlantic.—The Gulf Stream is to be distinguished from the broad drift into which it merges. The former has an inner circulation, which reaches to the Azores and to the region of the Trades, and circles round the Sargasso Sea; the Gulf Stream drift is a vast movement of the warm superficial waters of the Atlantic, driven by the prevailing south-west winds towards the north and east. The limit between the two, as determined by the directions taken by floating bottles, may be placed between 43° and 47° N. The drift spreads out in a fan shape, and branches into four streams, of which each goes towards one of the four straits which unite the North Atlantic with the Polar seas, viz.:—Davis Strait, Denmark Strait, the channel between Iceland and and the Faeroes, and that between the latter and Shetland. The circulation of the North Atlantic is strongly influenced by the conformation of the bottom of the sea. Other factors which enter into these movements are the melting of the polar ice, the relative salinity and temperatures of the various streams; and the seasonal variations in the circulation have a profound effect on the climate of these waters and the neighbouring lands. The complex relations of these various conditions are the subject of a study by Dr. O. Pettersson in *Petermann's Mitteilungen*, Nos. 3 and 4 of the present year. This essay, which is itself too condensed to admit of any shorter abstract, brings together the results of research in the North Atlantic until last summer, and is illustrated by charts and diagrams.

NEW BOOKS.

En Afrique avec le Missionaire Coillard. Par ALFRED BERTRAND. Genève: Ch. Eggiman et Cie., Éditeurs.

In our issue for October 1898 we had the pleasure of reviewing Captain Bertrand's *Au Pays des Ba-Rotsi, Haut-Zambèze*, in which he published an account of his expedition with Captain Gibbons into the country of the Barotze in

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Central Africa in 1895-96. In the volume now before us he gives an account of his journey with the venerable missionary Monsieur Coillard, from Southampton to Cape Town, thence to Basutoland, and thence across the Orange Free State to Bulawayo, where he parted with Monsieur Coillard, who proceeded on to the kingdom of the Barotze, where his mission has achieved a brilliant success. Captain Bertrand, however, struck north-east from Bulawayo to Salisbury and thence south-east towards Beira, striking the unfinished Salisbury-Beira railway at Russapec. He tells us that his programme was simply to accompany Monsieur Coillard to Bulawayo, so he never left the beaten tracks, and his present work has but little geographical interest. On the other hand it contains much interesting information regarding the progress of the missions founded by Monsieur Coillard in Basutoland. The book is well illustrated, and has a useful map reduced from one of the Royal Geographical Society of London.

A Geography of the British Empire. By LIONEL W. LYDE, M.A., F.R.S.G.S. London: Adam and Charles Black, 1900. *Price* 1*s.*

This little volume is one of Black's series of school textbooks. Mr. Lyde has condensed the geography of the whole British empire into 113 small pages, with the inevitable result that the information conveyed is not in sufficient detail for junior classes and is too superficial for senior classes. This can be easily understood when we mention that the geography of the United Kingdom is disposed of in ten pages, seven of which are given to towns alone. It would appear, however, from a paper of problems set at the end of the book that the work must be intended for advanced students, as the ordinary schoolboy could not be expected to answer such questions as these, "What difference would it have made if Ceylon had been situated where the Laccadivs are?" or "Discuss the probable history of India if the peninsula had been in the north and the continental part in the south?"

Among the Man-Eaters. By JOHN GAGGIN. (The Overseas Library.) London: T. Fisher Unwin, 1900. *Price* 1*s.* 6*d.*

This number of the Overseas Library contains a short series of sketches or tales regarding the Fiji and the Solomon Islands. They are at the hand of Mr. John Gaggin, who apparently began life as a cotton-planter in Fiji, and when that method of life turned out unsuccessful he entered the service of Government as an agent, and visited repeatedly the New Hebrides and Solomon groups in the Western Pacific. He writes easily and pleasantly about his experiences among the cannibals, and there are no signs of exaggeration or word-painting. A perusal of these sketches conveys to the reader a considerable amount of information regarding the appearance, customs, habits, etc., of races comparatively little known.

A Brief History of Eastern Asia. By L. C. HANNAH, M.A. London: T. Fisher Unwin, 1900. *Price* 7*s.* 6*d.*

Within a compass of 275 pages the author of this book endeavours to condense the history of all Asia, with the exception of Persia, Mesopotamia, Arabia, Syria, and Asia Minor, so it is hardly necessary to remark that the work is extremely sketchy and not very satisfactory. Dynasties are disposed of in half a page; the history of the first century of European interference in India is condensed into four pages; the story of the Mutiny into two. The abrupt transitions of place and time are confusing and distracting, although it may be conceded inevitable in such

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a work. For example, Chapter XVII. deals with the Mogul dynasty of Agra and ends with the death of Akbar in A.D. 1605, while the next chapter begins in the year A.D. 1318 with Go-Daigo, Emperor of Japan, and in four pages we have a sketch of the history of Japan for two and a half centuries. The book, which is brought up to January of the present year, may be of some use to the limited circle of readers who are contented with a mere outline of general history.

The Boer States, Land and People. By A. H. KEANE, late Vice-President, Anthropological Institute. With a Map. London: Methuen and Co., 1900. Pp. xx + 307. *Price* 6*s.*

Suggested doubtless by the events of the present time, this book is nevertheless sent forth, its author says, to serve a more than passing need. In truth, owing to these events, South Africa and the principalities now known as the Boer Republics, will for all time possess a peculiar and fascinating interest for people of our race. This book, however, has probably not the same destiny. It has been compiled with considerable literary skill, and with adequate knowledge and insight. It is not perhaps a mere piece of book-making. But it is, after all, nothing but a textbook of information up to date, much of which information is already recorded in other accessible and handy volumes. In the development of material, social, and political affairs, which, whatever its directions, will rapidly ensue upon the crisis through which the South African regions are passing, the volume will most likely before very long take its place upon the shelves for obsolete and forgotten manuals.

Geographically, the author gives a description of the physical features of South Africa—the land, with its mountain ranges, tablelands, and rivers; the climate, the flora, the fauna. He views these not merely as features of the earth's surface, but also as forming the physical environment which has contributed along with other influences to create the distinctive bodily and ethical characteristics of the Boers. This description is followed by a succinct account of the inhabitants, indigenous and immigrant. Here, again, the author points to those racial, ethical, and linguistic antecedents of the various Dutch, French, and German elements in the original European immigrant population, which have helped to make the character, customs, and language of the Boers what they are. Lastly, still keeping in sight the operation of environment and development, the author narrates the political and social history of this people, from the time when the first settlers were by the Dutch East India Company "manufactured on the spot out of the sailors and soldiers serving at the station" and that station was transformed from being "a military post to be the capital of a Colony," down to the outbreak of the present war. The historical sketch brings out clearly the effect upon the Boers of their rude and harsh treatment by their early Dutch rulers, next of their contact with the inferior dark races, and then of British Colonial policy and action, which may be described as having been professedly moral and morally weak. This sketch is very well drawn.

To all who have not already, from other books, made themselves acquainted with its subject, this book is to be commended.

Two Years in Palestine and Syria. By MARGARET THOMAS. Sixteen Illustrations in colour. London: John C. Nimmo, 1900. *Price* 12*s.* 6*d. net.*

Amid the many books on Palestine and Syria, one almost questions the need for another. But in spite of the multitude, Miss Thomas has justified her claim to be heard in this work from her pen, regarding the two years she

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spent in this the "least of all lands." Nothing new, perhaps, has she to add to what is already known, but as she says, she "speaks as an artist," and she writes as one. She has the faculty of being able to describe what she sees. It is this that gives value to the book. Landing you at Jaffa, she carries you by the railway to Jerusalem, and by her word-pictures shows the ancient city, its buildings, and its people, with a graphic touch that makes all vivid and lifelike. She masters the unsavoury smells, and faces the perils of an Eastern mob struggling for the sacred fire. She unfolds the charms of Olivet and the Garden of Gethsemane. And then she takes you to Bethlehem and Hebron, Jericho and the Jordan, Jacob's well and Mt. Gerizim, where she gives a most interesting account of the Samaritan Passover, which she witnessed, by the remnant who still cling to their ancient rite, dwindling in number. She leads you through Galilee with its lake of hallowed memories, to Damascus, and back to Baalbek with its magnificent ruins, and then to Beyrout, and down the coast by Tyre, Sidon, Carmel and Sharon to Jaffa. Bright incidents graphically told light up the story, and lodge it in the memory.

She mostly accepts the results of archæological discovery; but occasionally she falls into error. The Dead Sea she places 2603 feet below the level of the Mediterranean, whereas it is 1290 feet. She regards the enormous cave of Khareitun near Bethlehem as the Cave of Adullam, thus following a false tradition, instead of the hill up the Wady-es-Sur, called "Aid-el-ma," as the stronghold of David. The murder of John the Baptist she places in Herod's palace in Samaria, instead of in the fortress of Machærus.

The book does not add anything to our geographical knowledge, except in the historical aspect, by faithfully transcribing the condition of things at the present day, which still savour strongly of the past, but undergoing rapid change. It is enhanced by sixteen coloured illustrations of Jerusalem, from the brush of the authoress, and by sonnets of her own, not lacking in poetic merit.

Das Deutsche Land, in seinen charakterischen Zügen und seinen Beziehungen zu Geschichte und Leben der Menschen. By Professor Dr. J. KUTZEN. Fourth edition, completely revised by Dr. VICTOR STEINECKE. Breslau: Ferdinand Hirt. 1900. Pp. 587. Indices. 116 maps and illustrations: also 9 in colours. Price, 10 marks.

A work by Professor J. Kutzen in its fourth edition, thoroughly revised and brought up to date by Dr. Victor Steinecke, is on the face of it one of importance, and on examination we at once understand that it well deserves its success in Germany.

The book gives an account of Germany from the standpoint of modern science.

The first chapter deals with the geographical position of the country, then with its horizontal and vertical configuration, then with its waterways and climatic peculiarities, and finally with a description of the German race.

The second deals with the German Alps, their extent, geological formation, man in relation to them, their valleys, roads, passes, and lakes.

The other four chapters—dealing in the same detailed manner—are concerning the northern slopes of the Alps, the central steppes, the central German mountain region, and finally the northern German flats or low country.

Kutzen, the celebrated man who first planned and carried into effect his plan of this book, died in 1877, and since his death the science of geography, in its widest meaning, has made great advances, so that it was no easy task for the editor to re-write the book and bring it up to date in every way.

Dr. Victor Steinecke has performed this labour with conspicuous ability and

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success, and has provided his compatriots and others with a most interesting and at the same time entirely scientific account of the country of which the Germans are so justly proud.

The maps and illustrations are especially noteworthy, and serve in an admirable manner to elucidate the text.

It is no easy matter to compress a history of Germany into 587 pages, and yet the author has done it, and done it well, and brought into true relation the configuration of the country, its history, and its inhabitants.

We can confidently recommend this book to the notice of all students of modern Germany and her rise.

Instructions for the Prevention of Malarial Fever, for the use of Residents in Malarious Places. University Press of Liverpool. 1900. Second edition. Pp. 14.

Report of the Malarial Expedition of the Liverpool School of Tropical Medicine and Medical Parisitology. By Drs. Ross, Annette, and Austen. With supplementary reports. The University Press of Liverpool. 1900. Pp. 47. Addenda, 5 plates and 4 maps. Eight illustrations in text. Price, 10s. 6d.

These two exceedingly attractive volumes are the first-fruits of what we hope may be a very rich harvest to be presently reaped by the Liverpool School of Tropical Medicine.

At last the Empire, with the greatest tropical possessions in the world, has become alive to her duties, and special schools for the study of tropical medicine have been established in London and Liverpool, whilst special teaching in the same subject is given in our own Edinburgh University.

Edinburgh may be said to have led the van in this subject, for ever since 1886 lectures on the diseases of the tropics have been given in the Extra-academical Medical School, and last year the University itself instituted a course of lectures on tropical diseases.

The first memoir mentioned above, and which we have to notice, is an admirable yet short account of how to avoid malaria—that disease which slays its thousands and renders colonisation in the tropics almost if not quite impossible.

It is shown with *almost* absolute certainty that one species of mosquito—the Anopheles—transmits the disease to man. The question as to where the mosquito gets the malarial parasite is left severely alone at present; but we have to avoid getting bitten by these mosquitoes, and to destroy as far as may be their breeding-places, which are in small isolated muddy pools of stagnant water.

To summarise the exceedingly useful information given in this pamphlet would hardly seem to be justifiable, but every individual going to the tropics would do well to buy, read, and obey this most useful and indeed indispensable booklet.

This journal is hardly the place to review in any detail the second memoir. It is an account of the malarial expedition sent, under the leadership of Dr. Ronald Ross, to study the malarial question on the west coast of Africa.

The expedition was most successful in finding the special mosquito and its breeding-pools. An elaborate account of the whole subject is given, which will prove of the greatest use to all medical men, to whose special attention we commend it.

We warmly congratulate the Liverpool School of Tropical Medicine on its enterprise and on its present success, and very cordially wish it still greater success in the future.

The illustrations and micro-photographs are all that could be desired; and, as indicated above, both memoirs are very admirably produced.

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

BOTANICAL SURVEY OF SCOTLAND.

I.

EDINBURGH DISTRICT.

By ROBERT SMITH, B.Sc., University College, Dundee.

THE map accompanying the present paper is offered as a first contribution towards a botanical survey of Scotland, presenting the results of a closer study than has hitherto been attempted of the outstanding features of the vegetation. Since the summer of 1896 I have systematically surveyed most of the area included within the basins of the Tay and Forth, and although future work will doubtless suggest improvements and additions, enough seems now completed to warrant the publication of some of the results, to explain the method, and to invite co-operation in the task. Two sheets have been selected for present publication: one illustrating the district of Edinburgh, and the other that of North Perthshire—districts representative of Lowlands and Highlands respectively. The Edinburgh sheet accompanies the present paper, and the Highland sheet will follow in the August number of this *Magazine*.

Before passing to the detailed explanation of the map, it may be well to review briefly work of a similar nature already begun in other countries. Within recent years, increased attention has been paid by all students of the distribution of natural phenomena to the detailed or topographical aspects of the vegetation. The meteorologist has been attracted by the correlation between the distribution of plant life and the climate, the geologist by the connection between the vegetation and the nature of the subjacent soil and rock, and the general geographer by the conspicuous part that the vegetation plays in the landscape; whilst the agriculturist and forester recognise the value of the study of the natural vegetation in deciding what cultivated plants may be expected to yield fruitful crops over any particular area.

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I have recently discussed elsewhere (23)[1] the general programme of a vegetation survey. The chief points to be considered may be summarised as follows:—

(*a*) The chief zones or regions, characterised by definite plant associations, into which the district may be most conveniently divided.
(*b*) The particular conditions of heat, light, moisture, and food distinguishing each zone or region.
(*c*) The adaptations of the plant species to their environment.
(*d*) The relations existing between the species, *i.e.* which species are dominant, which secondary and struggling for position, and which dependent upon the dominant species for shelter or for food.
(*e*) The influence of animals and of man upon the associations.
(*f*) The general conditions of climate and of vegetation in the district compared with those in other districts.

Organised survey of the vegetation has not yet advanced far in Britain, and most of the facts which have been collected are scattered throughout general works, statistical accounts of particular districts, and introductions to local floras. On the Continent, however, there are already many excellent monographs giving very detailed accounts of particular regions, as for example certain by Drude (9), Pax (17), Radde (18), and others; and in the United States the vegetation has been included as one of the divisions of the government survey.

Until quite recently, vegetation maps were limited to the exhibiting of the broad zones and regions of the globe, such as are dependent on the great agents of distribution—sunlight, heat, and rainfall [the "geographical agents" of Drude (8)]. Yet as far back as the first decade of the nineteenth century, A. P. de Candolle (7) had planned out an elaborate map of France, intended to show the more detailed aspects of the distribution of plants, such as are dependent on the contour of the earth's surface, the physical and chemical nature of the soil, the competition between the species, etc. [the "topographical agents" of Drude (8)]. Unfortunately for the interests of science, he was unable, from political and other reasons, to carry out his project. A special difficulty with which he had to contend was the incompleteness of such topographical maps as were then available. Now, however, excellent maps, on which scientific observations may be recorded, are furnished by the Ordnance Surveys of most civilised countries, and the progress already made with geological surveys will facilitate comparisons between the vegetation and the subjacent soil.

Amongst the more detailed maps of the present day, an important place must be given to those constructed by the staff of the Department of Agriculture, U.S.A. (16). They represent North America divided into a number of latitudinal life-zones, each zone indicating a definite assemblage of plants, both natural and cultivated, an associated group of animals, and associated human industries.

The most complete vegetation map which has yet been attempted is

[1] These numbers refer to the bibliographical list at the end of the paper.

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that of France, now being prepared by Professor Flahault of Montpellier University, and of which the first sheet appeared in July 1897 (13). For its full description the reader is referred to the paper which accompanied it, along with its review in the *Scottish Geographical Magazine* for October 1897. On the present occasion, however, it is necessary to point out the principle upon which it is based, as it was largely by the experience gained while accompanying Professor Flahault on numerous surveying expeditions in France that I have been able to conduct similar experiments in Scotland, and to prepare the map which is now issued.

Professor Flahault's survey is essentially based on the distribution of the tree vegetation. A number of the trees of Europe are what are called "social" species, *i.e.* they tend to form forests where one species prevails, to the more or less complete exclusion of all others. Thus we find forests where beech, oak, or pine may predominate. Each tree has its own particular requirements, which limit it to definite regions dependent upon the prevalent climatic, soil, and other conditions. Thus, from a geographical point of view, forests of a particular tree indicate particular climatic and soil conditions; from a botanical point of view, the presence of particular associations of subordinate species; and from an economic point of view, regions suitably situated for the growth of certain cultivated species and for certain industries. Professor Flahault has, after careful consideration, selected certain trees which appear to be most characteristic in these respects. It is only necessary to study the attractive sheet which has been published, to see how well he has accomplished his task. Those who have had the good fortune to accompany him in the field know the singular and almost instinctive faculty which Professor Flahault has of seizing, as it were at a glance, such essential features of the vegetation.

The principle upon which such a map of the vegetation is based will be seen to be quite different from that of "floristic" maps, where the object is to show the actual areas of distribution of the species in such a way that they may be easily compared. This can be accomplished by representing the area of each species on separate maps of similar scale, as was begun for Britain by Watson in 1843 (28, 29), or on one map, as was attempted by Schübeler for Norway in 1878 (21). Those maps are of importance in the consideration of questions of the dispersion and migration of species. Vegetation maps, on the other hand—such as those prepared by Professor Flahault, or those of the present series—are not primarily concerned with the precise limits of the individual species, but show rather the distribution of a number of selected communities of plants which exist associated in nature. The species forming these communities are held together by their common requirements, and thus each association becomes indicative of a particular *ensemble* of environmental conditions.

Among those who have not followed the recent developments of this study, an impression appears to prevail that the relations between the vegetation and the factors regulating distribution are of so broad and general a nature as to admit of representation only on small-scale maps embracing large areas of the earth's surface. The importance of a more

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detailed method of research, however, has been fully vindicated by Professor Flahault in several papers (11, 12, 13). In the present paper I shall endeavour to indicate some of the many interesting problems which this method has suggested in the study of the vegetation of our own country.

To base the survey of the vegetation of Scotland on the distribution of the chief trees, as Professor Flahault has done for France, would give a very inadequate, if not erroneous, impression of the plant-covering of the country. The process of disforesting has proceeded so far in this country, that little primitive forest remains, and artificial planting has as yet only begun the reconstruction of the former woodlands. The general plant carpet of the country is thus formed by a type of vegetation lower than the arboreal, such as the cultivated plants, the grasses, the heaths, etc.; and in this carpet the woods occur only here and there as irregular patches. The main divisions of the present map, which seeks to show the outstanding features of existing plant life, have accordingly been determined by the dominant elements of this lower vegetation, whilst the trees have only been indicated over the limited areas which they actually inhabit.

Since, however, for the purpose of comparing the tree vegetation of the two countries, it would be of considerable importance to possess a map on the same plan as Professor Flahault's, careful record is being made of all evidence necessary for the determination of the areas which would be covered by the social trees indigenous to Scotland, were these allowed to distribute themselves naturally without hindrance from man. This evidence may be such as indicates the former presence of certain trees over particular areas, or such as considers the possibility of their growth in these localities at the present day. In the one case it would be derived from historical documents, place-names, and tradition, or from the examination of the contents of peat and other recent deposits, and in the other case from the study of the present vegetation, and of the climatic and soil conditions.

The maps of the Ordnance Survey already represent certain of the main divisions of the vegetation of the country. They distinguish the cultivated land from the uncultivated; they indicate the areas under wood, and, in those sheets recently published, even differentiate to a certain extent between deciduous and coniferous trees; they also mark off seaside dunes, links, sands, and rocks. The relative area occupied in Scotland by each of these divisions and by woodland can be seen at a glance on the "Naturalist's Map of Scotland" (4), where the scale has been reduced to that of ten miles to an inch. This map gives an excellent idea of the broad features of the vegetation of the country, and is the best of its kind that we yet possess.

EDINBURGH DISTRICT.

The district which is shown in the map accompanying this paper is lowland in character, nowhere rising above 2136 feet (649 metres). It is largely under cultivation. In the lower parts, at least, it is thickly populated, and human influence is evident everywhere, often obscuring the action of natural agencies on the distribution of the vegetation.

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Even to the casual observer of the vegetation, it will be evident that the two most marked divisions of the district are the cultivated area of the plains and lower slopes, and the uncultivated pasture and moorland of the hills. The fringe of uncultivated shore with its peculiar flora will also constitute an obvious division. These three divisions, then, which stand out most markedly, and which, as above-mentioned, are already indicated on the Ordnance maps, form the starting-point of the present survey. They may be designated:—

The Littoral Region.

The Region of Cultivation.

The Region of Hill Pasture and Moorland.

If the distribution of the tree vegetation is considered, it will be seen that the woods can be classified roughly into two groups—(1) woods of deciduous trees, and (2) woods of coniferous trees. These are the remnants of the two primitive tree regions which have been almost completely occupied by the regions of cultivation and of hill pasture and moorland. They will be treated apart from the three primary regions.

The extent of these regions and their subdivisions will be easily made out on the map, where they are shown as a series of more or less irregular zones rising from the shores of the Firth of Forth. The characters of each will now be considered.

The Littoral Region.

This region does not take an important place on the present sheet. There is a stretch of coast-line on both sides of the Forth, but much of it is occupied by harbour works and artificial embankments, and the

Shore at North Berwick. Dune grasses in foreground.

native flora has almost everywhere been largely replaced by the plants of cultivation, of waste places, and of ballast heaps—mostly casual species and aliens to the land. From this richness in foreign and often rare species, such localities have acquired a new interest to floristic botanists.

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Thus, for example, the ballast heaps of St. David's have long been a well-known hunting-ground, and are repeatedly mentioned in the various floras of the district. The true littoral flora, although much reduced, occurs here and there in patches along the coast, hardly any part being quite without salt-loving or halophytic plants. It is, however, only conspicuously developed in the neighbourhood of Gullane and North Berwick.

The littoral region is distinguished from the others by the part which common salt plays in the plant environment—occurring as it does in the water, soil, and atmosphere.

Although the presence of salt is necessary for the development of the halophytic vegetation, the actual grouping of the plants into the minor associations depends chiefly upon the particular amount of water present, and the nature of the substratum. Thus one association of plants inhabits the salt water, a second the salt marshes, a third the sandy shores and dunes, and a fourth the sea-side rocks. It may be of interest to point out the chief species constituting each of these four minor associations :—

1. *Plants submerged in salt water.*—Almost all of these are *Algæ*. The distribution of the *Algæ* throughout the Firth of Forth has been fully dealt with in papers by Trail (24, 25) and Rattray (19), to which reference is made. The genus *Zostera* includes the only flowering plants of this plant association.

Zostera marina, L., is of frequent occurrence.

Z. nana, Roth., has been reported by W. Evans (10) from the mud flats of Aberlady Bay, Torryburn, and west of the mouth of the Almond. [The presence of this species, however, is not confirmed by Sonntag (22) or Trail (26).]

2. *Plants inhabiting salt marshes.*[1]

Frequent species :—

Cochlearia officinalis, L.
C. danica, L.
Buda marina, Dum.
Aster Tripolium, L.
Glaux maritima, L.
Salicornia herbacea, L.
Sueda maritima, L.
Triglochin maritimum, L.
Scirpus maritimus, L.
S. rufus, Schrad.
Glyceria maritima, Mert. and Koch.

Rare species :—

Artemisia maritima, L., at Gullane and Aberlady (15), a species which on the east coast does not occur farther north than Aberdeen.

Beta maritima, L., in a few stations (15), possibly introduced, and here reaching its northern limit of distribution on the east coast.

[1] Some species have been excluded from this and the succeeding lists, either because the records of their occurrence have not been adequately confirmed, or because they are believed to have been recently introduced by man. The numbers given after certain stations in these lists do not necessarily refer to the first published record, but simply to the first local flora in which the stations are mentioned; there information regarding the first records will usually be found. The nomenclature is that of the *London Catalogue of British Plants*, ninth edition, 1895.

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3. *Plants inhabiting sandy shores and dunes.*

Frequent species:—

Thalictrum minus, L.
Cakile maritima, Scop.
Cerastium tetrandrum, Curtis.
Arenaria peploides, L.
Sagina maritima, Don.
Plantago Coronopus, L.
Atriplex Babingtonii, Woods.
Salsola Kali, L.
Scirpus maritimus, L.
S. rufus, Schrad.
Carex arenaria, L.
Phleum arenarium, L.
Ammophila arundinacea, Host.
Festuca rottbœllioides, Kunth. [*F. loliacea*, Curt.]
Agropyron junceum, Beauv.
Elymus arenarius, L.

Ammophila arundinacea, Host., is the dominant plant in this association.

Rare species:—

Glaucium flavum, Crantz (15). This is probably the northern limit of this species on the east coast, as it is now believed to be extinct in Kincardineshire, and the report of its presence in Elgin is doubtful (26).

Brassica monensis, Huds., has been reported by Sonntag (22) from between Grangemouth and Queensferry, its only station on the east coast of Scotland.

Crambe maritima, L. (1), here reaches its northern limit on the east coast.

Erythræa littoralis, Fr., at Gullane (15).

E. pulchella, Fr., at Gullane (15) and North Berwick (1), the only stations on the east coast of Scotland.

Carex incurva, Lightf., at Longniddry (1).

Festuca rubra, L., at North Queensferry (1).

Lepturus filiformis, Trin., at Aberlady and Gullane (1).

4. *Plants characteristic of seaside rocks.*

Frequent species:—

Silene maritima, With.
Ligusticum scoticum, L.
Armeria maritima, Willd.
Plantago maritima, L.

Rare species:—

Crithmum maritimum, L., is said to have been found on the islands of the Firth of Forth (15), but seems now to be quite extinct.

Asplenium marinum, L., at St. David's and Inchcolm (1, 15).

In these associations grasses and sedges, being social in habit, dominate over the other species, but competition for place is not keen.

There is one other association of plants which it is convenient to include with the littoral region, although it possesses many of the characters of the hill pasture and moorland. This is found inhabiting the seaside links or fixed dunes, which occur at certain points along the coast, particularly at Gullane. The flora constituting this association includes certain of the plants of sand-dunes, some pasture and heath species, some stragglers from cultivation, and in addition a few species almost peculiar to the station, which are not specially salt-loving, but which find here the dry sandy soil that they prefer, or at least a

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station less subject to competition between the inhabitants than occurs elsewhere in the district. The following list contains most of these species :—

Cerastium tetrandrum, Curtis.
C. semidecandrum, L.
Buda rubra, Dum.
Radiola linoides, Roth.
[at Gullane (22)].
Trigonella purpurascens, Lam.
(rare, Fife seems to be its north limit).
Trifolium arvense, L.
T. striatum, L.
T. scabrum, L.
Anthyllis vulneraria, L.
Astragalus danicus, Retz.
[*A. hypoglottis*, L.]
A. glycyphyllos, L.
Filago minima, Fr.
Leontodon hirtus, L.
(doubtfully native).
Erythræa centaurium, Pers.
Gentiana Amarella, L.
[at Gullane (15)].

The above lists show that the littoral region within the area of the present map possesses rather a meagre natural flora. In this respect it compares unfavourably with other sections of the coast of Scotland. This poverty, as already stated, can be ascribed to the changes brought about by the presence of numerous seaports. The region has, however, a certain floristic interest, as it contains, amongst its rare species, a few which here reach their most northerly point of distribution on the east coast of Scotland. The biological interest of the shore vegetation is great, because of the adaptations of the plants to the peculiar conditions of life. For the consideration of these, however, I refer to general works (*e.g.* 27), since the present paper is primarily concerned with the geographical aspect of the subject. The vegetation of the littoral region is of little value economically, compared with that of the other regions.

The Region of Cultivation.

(*Region of Temperate Europe.*)

The region of cultivation occupies most of the land between sea-level and an elevation of 1000 feet (304 metres). It is by no means uniform throughout its range of altitude, since the various cultivated crops have different requirements with regard to temperature, moisture, etc. Of the three chief cereal crops—wheat, barley, and oats—wheat requires the greatest amount of heat for the ripening of its grain, and accordingly its cultivation ceases at a lower elevation than that of the others. Thus the region may be divided into two sub-regions :—

(*a*) With wheat cultivation. (*b*) Without wheat cultivation.

These two sub-regions have been distinguished on the map.

The line which defines the upper limit of the wheat area has been drawn after personal observation of the position of the uppermost wheat fields in different parts of the district, and after consultation with a number of the farmers, whose advice in such a case has been of considerable value. I believe that it may be regarded as approximately marking the upper limits for the profitable cultivation of wheat under the present conditions of agriculture. It must, however, always be remembered that the two sub-regions pass almost imperceptibly into each other, the only change evident being the decrease in number and size of the wheat fields as the line is approached.

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A considerable portion of the cultivated region, as shown by the Ordnance maps, is actually under permanent pasture. This is especially the case near its upper border, where the vegetation is often the same as the adjoining hill pasture. To indicate this state of affairs where it is prominently developed, as for example near Harburn or West Linton, the green employed to represent hill pasture has been dotted over the colour for cultivation. The section of the cultivated area thus shown has an interest to the student of the agricultural history of the country, since it results from the increased attention which, within recent years, has been given to cattle and sheep raising, and from the diminished cultivation of cereals. The comparison between the agricultural returns of 1899 and of 1854, which is given below, will illustrate this change. For further consideration of this aspect of the subject, reference is made to the *Transactions* of the Highland and Agricultural Society, and the various agricultural periodicals, where the subject has frequently been dealt with.

These statistics from the Agricultural Returns will also indicate the crops grown in that part of the region of cultivation included in Midlothian.

Acreage under Crops and Grass in County of Midlothian.

		1899.	1898.	1854.
CORN CROPS	Wheat,	4,158	5,053	8,128
	Barley or Bere,	5,804	4,739	11,262
	Oats,	22,812	23,241	22,852
	Rye,	23	13	0
	Beans,	100	87	1,551
	Peas,	136	136	185
	Totals,	33,033	33,269	43,978
GREEN CROPS	Potatoes,	5,213	5,125	5,518
	Turnips and Swedes,	12,282	11,774	14,288
	Mangold,	41	24	
	Cabbage, K.-Rabi, and Rape,	1,005	910	89
	Vetches or Tares,	388	304	1,080
	Other Green Crops,	425	402	294
	Totals,	19,354	18,539	21,269
Clover, Sainfoin, and Grasses under rotation,	Hay,	12,249	13,049	34,204
	Not for Hay,	20,564	19,189	
	Totals,	32,813	32,238	34,204
Permanent Pasture (not broken up in rotation, and not including hill pasture),	Hay,	1,795	1,839	26,657
	Not for Hay,	45,484	47,994	
	Totals,	47,279	49,833	26,657
Small Fruit,		295	283	
Flax,		0	0	16
Bare Fallow,		59	30	635

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The altitudes to which the various crops ascend on the Pentlands differ considerably according to whether the exposure is to the north or to the south. The wheat limit on the northern slopes is in general about 500 feet (152 metres), while on the south-eastern slopes it reaches 700 feet (213 metres), and occasionally even higher, as for example on the farm of "House o' Muir," near the battlefield of Rullion Green, where, on a field of one acre at an altitude of 900 feet (274 metres), Mr. Foulis successfully reaped a wheat crop in the summer of 1899. The oat crop, which is the chief constituent of the upper sub-region of cultivation, usually ceases about 900 feet on the northern slopes, only occasionally passing 1000 feet (304 metres); whilst on the south side of the range it frequently reaches 1000 feet, and even here and there touches 1250 feet (380 metres). The influence of the exposure is thus very clearly demonstrated. The diagram attached to the map indicates these results more graphically, and at the same time shows their relation to the altitudes reached by the chief trees.

As has been pointed out by Dr. Buchan in 1862 (5a), a close connection can be traced between the meteorology and the vegetation. It has been shown that as a rule in Scotland, an average summer temperature of 56° F. (13·3° C.) is required for the ripening of wheat, although, as Dr. Buchan (5) points out, even 54·6° F. (12·5° C.) is sufficient, if the temperature is high during the day, and is accompanied by bright sunlight, especially at the times of flowering and ripening. We should thus expect to find that records of temperature throughout the area of wheat culture will at least show this average summer temperature of 56° F. In the following table statistics are given of the mean July temperatures for various places included in the map, the stations being arranged in their order of elevation above sea-level.

Table showing the Relationship between the Regions of Vegetation and the Temperature.

Region.	Locality.	Altitude in Feet.	Mean July Temperature (6a).
Wheat, . . .	Burntisland	40	58·2° F.
,, . . .	Leith	70	58·2° F.
,, . . .	Inveresk	90	58·2° F.
,, . . .	Aberdour	140	58·0° F.
,, . . .	Dalkeith	190	58·0° F.
,, . . .	Haddington	240	57·9° F.
,, . . .	Edinburgh	276	58·1° F.
Near limits of Wheat Region, . . .	Yester	420	57·7° F.
Upper Region of Cultivation, . . .	Rosewell	690	56·1° F.
Limits of Cultivation, .	North Esk Reservoir	1150	54·5° F.

A similar relationship between the regions of vegetation and the rainfall can also be shown. In the table given below, the statistics of rainfall, taken from Dr. Buchan's recent paper on the "Rainfall of

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Scotland" (6), have been arranged in the order of the altitudes of the localities, and plainly demonstrate a general increase in moisture with increasing elevation. The wheat region is distinctly drier than the others, none of the stations recording more than thirty inches of rain per annum. If a larger area were under consideration, it could further be indicated that, besides the altitudinal relationship between rainfall and vegetation, there is also a longitudinal relationship, since the amount of moisture increases as we pass westwards. Even within the narrow limits of the present map, a slight contraction of the wheat region on the western side may be observed, a contraction which would become very evident indeed were we to extend our survey still farther to the west.

Table showing the Relationship between the Regions of Vegetation and the Rainfall.

Region.	Locality.[1]	Altitude in Feet.	Annual Rainfall in Inches.
Wheat Region,	*Aberlady*		26·02
	Grange, Bo'ness	20	28·80
	Inveresk	30	28·93
	Leith	70	26·08
	Abercorn	130	29·54
	Haddington	140	26·85
	Dalkeith	183	24·55
	Edinburgh (Charlotte Square)	230	26·71
	Tyneholm	248	27·25
Near limits of Wheat Region,	*Yester*	425	31·84
Upper Region of Cultivation,	Swanston	550	33·73
	Rosewell	695	32·78
	Clubbiedean	750	37·16
	Glencorse	787	39·68
	Harlaw	800	36·28
	Loganlee	850	45·35
	Cobbinshaw	863	38·10
	Gladhouse	900	36·86
	Harperrig	900	37·27
	Crosswood	950	40·23
Region of Hill Pasture and Moorland,	*Harbour Hill*	1112	37·88
	N. Esk Reservoir	1150	38·21
	Cairnmuir	1150	43·22

Since the value of the land is to a considerable extent dependent upon its agricultural produce, there should be a correspondence between the present map and one showing regions of similar annual rental. Such a map has been prepared for Midlothian by Mr. Ralph Richardson (20). It shows the county subdivided into a number of parts, each of which represents land of a particular range of annual rental. The first division —land under £1 per acre—includes the hill land and the poorest of the cultivated land. It corresponds in general to the region of hill pasture

[1] Stations in *italics* indicate that returns for the whole of the twenty-five years, 1866-1890, are not available, but the means here given have been calculated for these twenty-five years, by differentiation, from stations in the vicinity.

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and moorland as shown on the present map. Similarly, the second division—£1 to £2 per acre—corresponds to the upper sub-region of cultivation, and the area included by the next three divisions—£2 to £5—to the region of wheat cultivation. Mr. Richardson's further divisions —£5 and upwards—are all in the immediate neighbourhood of Edinburgh (the last—£20 to £40—being the irrigation meadows between Leith and Portobello), and have no analogue on the vegetation map.

There is still one other important factor besides the altitude, exposure, temperature, rainfall, and land value, with which it should be possible to compare the distribution of the vegetation, namely, the nature of the soil. A map showing the different soils is however still lacking, and, further, the soils of the cultivated area can now be so greatly altered by human control, that within the region of cultivation they are of reduced value in determining the nature of the vegetation. When considering the region of hill pasture and moorland, however, certain definite relations between the vegetation and this factor will be indicated.

The region of cultivation does not present the same floristic interest as the littoral region, except in aquatic localities and in woods, for most of the species have been introduced more or less recently with the various crops with which they are associated. Certain of these species seem to follow closely throughout Scotland the distribution of particular crops, and to have similar conditions of life; but until further survey has been made, I have decided to withhold the lists.

Tree Regions.

As already mentioned in this paper, the attempt has been made to show on the map the dominant social trees inhabiting the patches of woodland. Four of the trees native to Scotland form well-marked societies, namely, the oak, birch, alder, and Scots pine. Probably in early times the oak forests covered the plains and lower hills, and the pine and birch forests the slopes of the higher mountains up to the limits of tree growth, whilst the alder formed dense copses in the swamps. In the district which we are considering, timber production has become quite subordinate to agriculture, and none of this primitive forest remains. Very little of the wood is self-sown, and only a few thickets of birch and alder on the sides of some of the valleys can be regarded as quite natural. All other woods have been more or less recently planted by man, often with little regard to the natural mode of occurrence of the trees. In this planting many foreign species have been introduced, such as beech, Spanish chestnut, horse chestnut, lime, sycamore, larch, and spruce, thus further modifying the primitive aspect of the woodland.

Of the introduced species of trees, three—the beech, larch, and spruce—are social, like the four native species above-mentioned. Thus seven different types of pure wood might be found, as each species differs slightly from the others in its requirements, and will in favourable conditions dominate over all competitors. In some parts of Scotland these seven different types of woodland do exist, but here few pure plantations can be found. In the low grounds several beech woods occur almost free

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from other species, and the same is true of many of the Scots pine woods on the hills; the oak, too, in a few localities, such as near Gifford and Borthwick, has been planted with little admixture. Most of the plantations, however, contain a mixture of species. Accordingly, in this district I have judged it sufficient on the present scale of survey to distinguish only the two main types, namely—

1. Woods of deciduous trees, mainly beech and oak.
2. Woods of coniferous trees, mainly Scots pine.

A mixture of these two types is also indicated.

As a general rule, the deciduous trees occupy the lower ground, corresponding to the primitive oak region, and the coniferous trees the slopes of the hills, corresponding to the primitive pine and birch region.

This distinction between deciduous and coniferous trees is of considerable importance in comparing the regions of vegetation of Scotland with those of Europe in general. The separation between temperate and sub-Arctic Europe, or between the temperate region and the sub-Alpine region of the mountains of Europe, is usually marked by the change in character of the trees—deciduous species indicating the warmer, and conifers the colder regions. This point will be considered at greater length in the paper on the map of North Perthshire, since the tree vegetation is there more natural and more fully developed.

Region of Deciduous Trees.

(*Region of Temperate Europe.*)

This is represented by plantations, parklands, and "dens." Although beech and oak are the chief tree species, numerous others also occur, of which the more important having claims to be considered as indigenous are given in the following list:—

Ilex Aquifolium, L. (Holly).
Prunus spinosa, L. (Sloe).
P. Avium, L. (Gean).
[Possibly introduced.]
P. Padus, L. (Bird Cherry).
Pyrus Aria, Ehrh. (White Beam Tree).
[Probably introduced.]
P. Aucuparia, Ehrh. (Rowan).
P. Malus, L. (Crab Apple).
[Possibly introduced.]
Cratægus Oxyacantha, L. (Hawthorn).
Sambucus nigra, L. (Elder).
[Possibly introduced.]
Fraxinus excelsior, L. (Ash).
Ulmus montana, Stokes (Wych Elm).
Betula alba, L. (Birch).
Alnus glutinosa, Medic. (Alder).
Corylus Avellana, L. (Hazel).
Quercus Robur, L. (Oak).
Salix spp. (Willows).
Populus spp. (Poplars).

These woods of deciduous trees occur throughout the region of cultivation, but as the altitude increases they become smaller, and the trees are less well grown. As will be seen by the diagram accompanying the map, they cease about 800 to 900 feet (243-274 metres) on the north slopes, and about 900 to 1000 feet (274-304 metres) on the south slopes of the Pentlands. The last patches of deciduous woodland coincide approximately with the last cultivated fields, and often serve to shelter them from the wind. Thus, it can be noted that a great many of these

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shelter-belts run in a general way from north-west to south-east, or north to south—directions which allow them to most effectually oppose the force of the prevalent westerly and south-westerly winds.

The flora of the deciduous woods in this district is relatively poor, and almost without definite character; only in some of the older woods,

Woods on south shore of Firth of Forth, east of Cramond.
Mainly composed of deciduous trees.

such as Arniston, or in dens, such as Hawthornden, are the peculiar wood-plants, with adaptations to shade, humus, and moisture, at all well developed.

The following list includes the frequent plants of the deciduous woods of this district :—

Anemone nemorosa, L.
Ranunculus auricomus, L.
**R. Ficaria*, L.
Cardamine flexuosa, With.
**Viola Riviniana*, Reich.
Lychnis dioica, L.
Stellaria nemorum, L.
S. Holostea, L.
**Arenaria trinervis*, L.
Hypericum pulchrum, L.
H. hirsutum, L.
Geranium sylvaticum, L.
G. pratense, L.
**G. Robertianum*, L.
Oxalis Acetosella, L.
**Rubus idæus*, L.
**R. fruticosus*, L.
R. saxatilis, L.
**Geum urbanum*, L.
**G. rivale*, L.
**Geum rivale* × *urbanum*.
**Fragaria vesca*, L.
**Rosa* spp.
**Epilobium montanum*, L.
**Circæa lutetiana*, L.
Sanicula europæa, L.
Angelica sylvestris, L.
**Hedera Helix*, L.
Adoxa Moschatellina, L.
**Lonicera periclymenum*, L.
Asperula odorata, L.
Valeriana sambucifolia, Willd.
Solidago Virgaurea, L.
Cnicus heterophyllus, Willd.
Campanula latifolia, L.
Primula acaulis, L.
Lysimachia vulgaris, L.
L. nemorum, L.
Symphytum tuberosum, L.
**Myosotis sylvatica*, Hoffm.

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**Solanum Dulcamara*, L.
**Scrophularia nodosa*, L.
Digitalis purpurea, L.
Veronica montana, L.
**Nepeta Glechoma*, Benth.
**Stachys sylvatica*, L.
Teucrium Scorodonia, L.
**Ajuga reptans*, L.
Mercurialis perennis, L.
**Listera ovata*, R. Br.
**Epipactis latifolia*, All.
**Orchis mascula*, L.
**O. maculata*, L.
Habenaria bifolia, R. Br.
Allium ursinum, L.
Scilla festalis, Salisb.
Luzula vernalis, DC.
L. maxima, DC.
L. campestris, DC.
Carex remota, L.
C. flacca, Schreb.
Carex sylvatica, Huds.
C. lævigata, Sm.
C. hirta, L.
**Holcus mollis*, L.
**Dactylis glomerata*, L.
Poa nemoralis, L.
Bromus giganteus, L.
B. ramosus, Huds.
Brachypodium gracile, Beauv.
**Agropyron caninum*, Beauv.
Pteris aquilina, L.
Lomaria Spicant, Desv.
**Athyrium Filix-fœmina*, Roth.
Polystichum lobatum, Presl.
**Lastræa Filix-mas*, Presl.
**L. dilatatá*, Presl.
Polypodium vulgare, L.
Phegopteris Dryopteris, Fée.
P. polypodioides, Fée.
Equisetum maximum, Lam.
E. sylvaticum, L.

To this list might be added numerous others which occur frequently in the woods, but which are to be regarded as invaders from the surrounding fields and hedges, and not as members of the true wood association. In the newer plantations this is very distinctly the case, for most of the dominating species belong to this invading class, and only a limited number of the true wood plants are to be found.

In the above list I have marked with an asterisk all the woodland species which were, after a careful search, observed in one of the newer plantations near Inverkeithing. In the more shady parts of this plantation only one or two species are found, in particular a few kinds of fern and *Arenaria trinervis*. Where enough light penetrates the canopy of trees to allow the ground to be covered with vegetation, a limited number of social species—mostly of the invading class—form the plant-carpet, each respectively dominating where it can find the conditions of moisture, soil, and light best suited to it. These dominant species are :—

Ranunculus repens, L.
Spiræa Ulmaria, L.
Rubus idæus, L.
R. fruticosus, L.
Fragaria vesca, L.
Urtica dioica, L.
Juncus conglomeratus, L.
Phalaris arundinacea, L.
Anthoxanthum odoratum, L.
Agrostis vulgaris, With.
Deschampsia cæspitosa, Beauv.
Holcus mollis, L.
H. lanatus, L.
Lastræa Filix-mas, Presl.
Polytrichum commune, L.
Pellia epiphylla, L.
(on the sides of ditches).

Certain species inhabiting the deciduous woods have suffered so much from the removal of the old forests, and the inroad of the invading

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species, that they only linger on in a few isolated stations as survivals of an earlier flora. The chief of these are given in the following list :—

Trollius europæus, L.
Viola hirta, L.
Vicia Orobus, DC.
V. sylvatica, L.
Crepis succisæfolia, Tausch.
Campanula Trachelium, L.
Melampyrum pratense, L.
Lathræa squamaria, L.
Stachys Betonica, Benth.
Neottia Nidus-avis, Rich.
Cephalanthera ensifolia, Rich.
Gagea fascicularis, Salisb.
Paris quadrifolia, L.
Carex pendula, Huds.
Milium effusum, L.
Melica nutans, L.
M. uniflora, L.
Festuca sylvatica, Vill.
Scolopendrium vulgare, Symons
Equisetum hyemale, L.

Region of Coniferous Trees.

(*Region of Sub-Arctic or Sub-Alpine Europe.*)

The Scots pine (*Pinus sylvestris*, L.) is the dominant tree species of this region, many of the woods being almost entirely composed of it.

Willows and Pines on the shores of Glencorse Reservoir, Pentland Hills.

Larch is often planted with the pine, but is usually thinned out early, as it soon reaches an age when it becomes of value for pit-props, etc., and also because in this district it is very liable to be affected by canker caused by the fungus *Dasyscypha* (*Peziza*) *Wilkommii*, Hartig. It is unlikely that it will ever take the place of the native pine. Spruce

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grows well in some parts, especially where the soil is moist, but since its market value is not great, it is nowhere abundantly planted.

The coniferous woods are characteristic of the upper sub-region of cultivation and of the lower part of the region of hill pasture and moorland. Although most woods are below 1250 feet (380 metres), yet a few occur up to near 1500 feet (456 metres), as for example on South Black hill in the Pentlands, or on Dod Law in the Moorfoot hills. Many of the trees at this altitude are stunted, but probably with careful planting most of the hills could, if desirable, be covered with forest; there seems to be no climatic reason against it, and even in the highest woods there occur trees furnishing timber of sufficient value to warrant the attempt. The paper accompanying the North Perthshire map will deal more fully with these arboricultural questions, which in that region assume much greater importance.

Pine woods near Logan Lee, Pentland Hills.

The plants inhabiting these pine woods do not form so marked a group as those of the deciduous woods, and since the shade afforded by the trees is not very deep, and the ground is often peaty, the flora much resembles that of the moorland and hill pasture. One of the plantations near Belstane, on the north slopes of the Pentlands, can serve as an example, since its vegetation is fairly characteristic of all the pine woods of the district. Its altitude is about 700 feet (213 metres). The ground is flat, tending to accumulate water, but is artificially drained. The trees are almost full-grown. A few larch and spruce are mixed with the dominant Scots pine. The pines are in very good condition, and better than the other two species. The trees are well apart—roughly, 10 to 20 feet—thus allowing a considerable amount of light to penetrate. As a result, the ground is covered with vegetation. The depth of shade and the amount of moisture are the two chief conditions determining the species which will dominate under the trees. Heather is not abundant, only occurring on dry peaty soil near the edges of the wood. This in itself indicates the relatively recent age of the wood and its artificial

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nature, for as a rule heather is characteristic of all the light parts and clearings of old pine woods. Rushes occur on the wet clay soils. *Molinia varia*, Schrank., is abundant on wet peaty soils with imperfect drainage. Tussocks of *Deschampsia cæspitosa*, Beauv., clothe the edges of the drains and compete in marshy places with the rushes. Better grasses, including species of *Poa*, *Holcus*, *Agrostis*, and *Festuca*, carpet the well-drained parts where the soil is good. Self-sown seedlings of birch, rowan, and willow occur frequently, showing an attempt at the re-establishment of the primitive trees. The only other conspicuous plants in the limited flora of this wood are:—

In open places—

Rubus fruticosus, L.

Associated with both heather and grasses—

Oxalis Acetosella, L. *Galium saxatile*, L. *Lomaria Spicant*, Desv.
Potentilla silvestris, Neck. *Veronica Chamædrys*, L.

Associated with the better grasses—

Athyrium Filix-fœmina, Roth. *Lastræa dilatata*, Presl.
Lastræa Filix-mas, Presl.

Associated with *Deschampsia cæspitosa*, Beauv.—

Scabiosa Succisa, L. *Cnicus palustris*, Willd.

Three mosses are frequent, namely—

Dicranum scoparium, Hedw. *Hypnum Schreberi*, Willd.
Polytrichum commune, L.

Few of the characteristic plants of old pine woods now remain in any part of this district. Those mentioned in the following list have been reported as still lingering on, but every year their situation becomes more precarious:—

Linnæa borealis, L.—Fir plantation at Ravelrig (1).
Pyrola rotundifolia, L.—Near Auchindinny (15). [Its presence now is regarded as doubtful by Trail (26).]
Pyrola media, Sw.—A few stations only.
Pyrola minor, L.
Pyrola secunda, L.—Reported from Bo'ness by Sonntag (22).
Trientalis europæa, L.
Corallorhiza innata, R. Br.—Ravelrig (15), Culross, Dunfermline (1).
Moneses grandiflora, Gray, has been recorded from Harburn Fir wood,[1] but seems now to be extinct.
Listera cordata, R. Br.
[*Goodyera repens*, R. Br., a species of which the presence might have been expected, has not, so far as I can ascertain, been recorded from this district.]

The Region of Hill Pasture and Moorland.

(*Region of Sub-Arctic or Sub-Alpine Europe.*)

The region of hill pasture and moorland includes the upland area

[1] Statistical Account, Edinburghshire, 1845, p. 305.

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lying beyond the limits of cultivation. This consists of the whole of the Pentland range, part of the Cloich, Moorfoot, and Lammermuir ranges, and numerous isolated hills such as Dalmahoy, Arthur's Seat, North Berwick Law, etc. Over this area human influence, although still evident, is reduced, and the action of natural agencies, such as exposure, moisture, soil constitution, etc., can be more easily observed and their effects estimated. Careful consideration is required before deciding what subdivisions are valuable for cartographic representation. It will be seen that on the map two colours in particular have been used to indicate this region, which are described as denoting heather and hill pasture respectively.

These two chief divisions will at once commend themselves for the ease with which they can be recognised, as the brown heather stands out very sharply from the green or yellow hill pasture. But their selection depends upon a more scientific basis than simply ease of recognition. They are respectively representative of two different types of vegetation. The heather requires for its growth the presence of a certain amount of peat in the soil, whilst the grasses require a soil moderately rich in mineral salts. Further, the heather grows most freely where the subsoil is not specially retentive of moisture, and it can resist periodic drought more easily than the majority of the grasses.

This general statement regarding the different characters and requirements of the two kinds of vegetation will be more fully comprehended by a consideration of each of the areas separately.

Heather Association.

This association, as will be seen by the map, is best developed on the Pentlands. Elsewhere in the district, it occurs in patches usually

Heather on the "screes" of the Black Hill, Pentland Hills.

inconsiderable in extent. At the north-eastern or Edinburgh end of the Pentlands, the heather caps most of the summits, but grows poorly on the slopes. The chief condition of its development on these hills

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is the presence of a poor and thin soil where a certain amount of moss (*Polytrichum* and *Dicranum* chiefly) has formed "rain-wash" peat. It is especially abundant on the microgranite of the Black hill and the poor trachytes of the South Black hill and Scald Law.

On the upper parts of the Black hill only three or four species grow along with it, so completely does it predominate. Over a considerable area on the east shoulder, almost its only associates are *Erica cinerea*, L., *Vaccinium Myrtillus*, L., and *Potentilla silvestris*, Neck., any richer vegetation being restricted to isolated marshy places or to patches of boulder-clay.

The following list of plants of the heather area on Carnethie hill is more typical of the composition of the association. The plants are arranged in order of importance, *Calluna* being by far the most abundant:—

Calluna Erica, DC.
Erica cinerea, L.
Potentilla silvestris, Neck.
Galium saxatile, L.
Vaccinium Myrtillus, L.
Agrostis vulgaris, With.
Lathyrus montanus, Bernh.
Lotus corniculatus, L.
Campanula rotundifolia, L.
Deschampsia flexuosa, Trin.
Galium verum, L.
Pteris aquilina, L.
In addition, isolated individuals of several other species are found.

The heather association found on dry thin soils, and of a composition closely similar to that just described, is known to German botanists as "*Heide*," and it may be convenient to employ the English equivalent "Heath" as a corresponding technical term.

It will be seen on examination of the map that as we pass westwards the heather area increases. It also alters in character. *Calluna* still remains the dominant element, but the association includes species of a moister habitat. The ground here is less steeply inclined and moister than at the north-eastern end, although the soil and rock are still poor. The peaty component of the soil is here more abundant, and now largely formed from *Sphagnum*. The following list from the ridge of West Cairn hill near the Cauldstaneslap will show the presence of the moister element in the association (marked by an asterisk):—

Calluna Erica, DC.
Potentilla silvestris, Neck.
Galium saxatile, L.
**Erica Tetralix*, L.
**Empetrum nigrum*, L.
**Scirpus cæspitosus*, L.
**Juncus squarrosus*, L.
Polygala vulgaris, L.
Luzula campestris, DC.
Nardus stricta, L.
Anthoxanthum odoratum, L.
Lomaria Spicant, Desv.
Vaccinium Myrtillus, L.

Such an association corresponds to the "*Heidemoor*" of German botanists, and might be distinguished by us from the "heath" by the name of "Heather-moor."

A third variety of the heather association occurs where the soil is still moister and peat present in still greater quantity. Here living *Sphagnum* takes an important place amongst the constituents of the

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community. A good example is found at Cobinshaw Moss, where the following plants form the characteristic vegetation :—

Calluna Erica, DC.
Eriophorum vaginatum, L.
Sphagnum spp.
Erica Tetralix, L.
Empetrum nigrum, L.
Scirpus cæspitosus, L.
Molinia varia, Schrank.
Schollera Oxycoccus, Roth.
Drosera rotundifolia, L.

This association is known in Germany as a "*Sphagnum-moor*" or "*Moos-moor*," and "*Sphagnum*-moor" or "Moss-moor" may be used to indicate it in English.

Three fairly well marked varieties of the heather association can thus be distinguished on the Pentlands—heath, heather-moor, and *Sphagnum*- or moss-moor. These agree in requiring a peaty soil, they differ in the amount of water necessary for their development—the heath being developed in the drier, the others in the wetter localities. They are always found more or less intermixed. Thus, although the Black hill is mainly covered with the heath association, yet small patches of the heather-moor and moss-moor occur; again on West Cairn hill, although much of the vegetation belongs to the heather-moor type, the other two are by no means absent.

At first survey it seemed impossible to adequately represent any of the subdivisions of the heather area on a map of the present scale. I have, however, decided to show the larger areas occupied by the *Sphagnum*-moor association, such as are found at Cobinshaw, Auchencorth, Fala, etc. Even this has not been quite satisfactory, as large portions of these old mosses have been drained within recent years, their original vegetation changing greatly in consequence. The areas actually peopled by such a community as mentioned above for Cobinshaw, have become very much reduced, and heath, grass pasture, or even cultivated fields have replaced them. Part of the primitive *Sphagnum* area is thus included on the map with cultivation, and part with pasture. The remainder, still under *Sphagnum*, or having clearly been in that condition until recently, but now covered with different varieties of the heather association, has been distinguished on the map by a different shade of colour from the general heather association. In the scheme of colours attached to the map, this is said to indicate, "Peat bogs usually with heather, *Eriophorum*, etc., dominant," and although this is true, it will be seen from the description given above that these areas might more precisely be described as parts of the primitive moss-moor which have been more or less drained, but are not yet under good pasture or cultivation.

Throughout this account of the heather association, the lists of species have been kept as short as possible, in order to show only the outstanding species of each sub-association. The following lists will supplement those already given. The first two contain species which, like the heather, seem to be quite dependent, at least under natural conditions, on the presence of peat in the soil. These have been separated into two lists to indicate, in a general way, whether they belong to the dry or wet varieties of the heather association.

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Peat plants in dry conditions.	Peat plants in moist conditions.
Potentilla silvestris, Neck.	*Rubus Chamæmorus*, L.
Antennaria dioica, R. Br.	*Saxifraga Hirculus*, L.
Vaccinium Vitis-Idæa, L.	*Schollera Oxycoccus*, Roth.
V. Myrtillus, L.	*Andromeda Polifolia*, L.
Calluna Erica, DC.	*Erica Tetralix*, L.
Erica cinerea, L.	*Myrica Gale*, L.
Listera cordata, R. Br.	*Empetrum nigrum*, L.
Nardus stricta, L.	*Juncus squarrosus*, L.
Lomaria Spicant, Desv.	*Molinia varia*, Schrank.

With fuller study, it will probably be easy to add to these lists from amongst the following species, which are also found closely associated with *Calluna*, especially in its drier habitats, although I am unable at present to assert their invariable association with humus or peat.

Polygala vulgaris, L.	*Rumex Acetosa*, L.
Hypericum humifusum, L.	*R. Acetosella*, L.
Genista anglica, L.	*Salix repens*, L.
Galium saxatile, L.	*Carex binervis*, Sm.
Crepis virens, L.	*Deschampsia flexuosa*, Trin.
Hieracium Pilosella, L.	*Lastræa dilatata*, Presl.
Gnaphalium sylvaticum, L.	*Lycopodium Selago*, L.
Campanula rotundifolia, L.	*L. clavatum*, L.
Thymus Serpyllum, Fr.	*L. alpinum*, L.

Andromeda Polifolia, L., which is mentioned amongst the peat plants, is only recorded from one station, namely, Auchencorth Moss (14). It may be regarded as a species which has become almost extinct through the draining of the *Sphagnum* bogs.

Saxifraga Hirculus, L., of similar nature, has been found on the Pentland hills, in only one station, near the source of the river Medwin (1).

Schollera Oxycoccus, Roth., although not yet so rare as these two just mentioned, is also becoming of more and more restricted distribution with the progress of drainage operations.

One species which is associated with the dry *Calluna* heath in many parts of the Highlands seems to be quite absent from the Pentlands, namely, *Arctostaphylos Uva-ursi*, Spreng. This is rather remarkable, as it occurs on the Sidlaws in localities almost identical with parts of the Pentlands. It is, however, so far as I have observed, restricted there to the eastern or Forfarshire end of the range, and to a part which is not frequently burned. It is possible that the regular heather-burning on the Pentlands may have caused or aided its extirpation if it ever occurred there. It is a species which might be searched for yet on such hills as the Black hill, Scald Law, or the Cairn hills.

Grass Associations or Hill Pasture.

Almost all the uncultivated land amongst the hills may be called pasturage, since sheep are grazed over it, and manage to find everywhere some kind of vegetation upon which they can feed. The term as used here, however, has been taken to mean those parts where grasses are

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well developed, and where the heather and its associates are in contrast scarce or absent. Such pasture, almost or quite free from heather, covers in particular the isolated hills of the plains, and the Lammermuir, Moorfoot, and Cloich ranges; on the Pentlands it is, on the whole, secondary to the heather area.

The grass association, like that of the heather, is by no means uniform, varying with the nature of the soil, the amount of moisture, the exposure, etc. After considering its characters throughout its range, the most natural subdivision seems to be according to the three main types of hill, namely—

1. Pasture of the Basaltic Hills.
2. Pasture of the Silurian Hills.
3. Pasture of the Pentlands.

The characters of each of these will now be considered separately.

1. The basaltic hills of the district occur as isolated knolls rising from the plains, including in their number Queensferry hill, Dalmahoy hill, Kaimes hill, Craiglockhart, Arthur's Seat, Garleton hill, North Berwick Law, etc. These hills are composed of rocks rich in mineral salts, including especially those of calcium and magnesium. The rocks disintegrate into a friable porous soil. Moss does not readily form, and the humus plants are almost absent; and when present are, in several cases at least, not directly in the soil formed from the subjacent rock, but in that from some superficial poorer glacial deposits. The vegetation is richer than that of the other parts of the pasture area. The following classified list from Dalmahoy hill may be taken as typical :—

Grasses—

Agrostis spp.
Festuca ovina, L.
Anthoxanthum odoratum, L.
Poa pratensis, L.
Poa trivialis, L.
Sieglingia decumbens, Bernh.
Nardus stricta, L. (on the very poorest parts only).

General Pasture Plants—

Viola Riviniana, Reich.
V. lutea, Huds.
Trifolium repens, L.
Lathyrus montanus, Bernh.
Potentilla silvestris, Neck.
Galium verum, L.
G. saxatile, L.
Achillea Millefolium, L.
Campanula rotundifolia, L.
Vaccinium Myrtillus, L. (only occasional).
Erica cinerea, L. (only occasional).
Luzula campestris, DC.
Lastræa dilatata, Presl.

Plants occurring especially where rock near surface—

Helianthemum Chamæcistus, Mill.
Arenaria serpyllifolia, L.
Cnicus lanceolatus, Willd.
Cnicus arvensis, Hoffm.
Teucrium Scorodonia, L.
Rumex Acetosa, L.

Two other species are so characteristic of these basaltic hills that I mention them apart from the others, namely, the whin or gorse (*Ulex europæus*, L.), the golden blossoms of which form a conspicuous element of the landscape in the early spring, and the bracken (*Pteris aquilina*, L.), which tinges the slopes a characteristic russet-brown with its dying fronds in the fall of the year.

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Quite a number of species are in the district, largely or almost entirely confined to the whinstone or basaltic hills. They are chiefly species near the north limit of their distribution, which seem to find on these hills, with their rich dry soil, the nearest approach to the life-conditions of more southern habitats. In this respect they resemble the peculiar species of the seaside links, mentioned above when treating of the littoral region. The following list contains the more frequent of those species (a few are included which, although common enough in other stations, yet seem best developed in this station) :—

Arabis hirsuta, Scop.
Reseda Luteola, L. (doubtfully native).
Helianthemum Chamæcistus, Mill.
Viola hirta, L.
Dianthus deltoides, L.
Lychnis Viscaria, L.
Cerastium semidecandrum, L.
Arenaria serpyllifolia, L.
Sagina subulata, Presl.
Hypericum perforatum, L.
Geranium sanguineum, L.
G. pyrenaicum, Burm. fil.
Ulex europæus, L.
Ononis repens, L.
Trifolium arvense, L.
T. striatum, L.
Trifolium procumbens, L.
T. dubium, Sibth.
Anthyllis Vulneraria, L.
Astragalus danicus, Retz.
Vicia hirsuta, Gray.
Potentilla verna, L.
P. argentea, L.
Sedum acre, L.
Pimpinella Saxifraga, L.
Echium vulgare, L. (probably introduced).
Origanum vulgare, L.
Calamintha Clinopodium, Spenn.
Teucrium Scorodonia, L.
Allium vineale, L.
Asplenium Trichomanes, L.

The rare forms, almost or quite confined to these hills, are :—

Silene nutans, L., North Queensferry (15).
S. italica, Pers., introduced on Salisbury Crags and Arthur's Seat (1).
Arenaria verna, L., Salisbury Crags, Arthur's Seat, and Blackford hill (15), North Queensferry (22).
Oxytropis uralensis, DC., North Queensferry (15).
Vicia lathyroides, L.
Calamintha arvensis, Lam.
Asplenium germanicum, Weiss., Blackford hill [Dr. Andrew Inglis (1)], probably extinct.
A. septentrionale, Hull, Arthur's Seat and Blackford hill (15).

2. The Silurian hills of the present sheet include parts of the Cloich, Moorfoot, and Lammermuir ranges, and a small part of the Pentland range. Their aspect is characteristic. If, for example, the Moorfoots are approached from the north, they appear as steep grassy slopes with no projecting rocks or cliffs. The streams issuing from them run in deep narrow valleys clothed with grass and bracken to the skyline. When these steep slopes are climbed, the nature of the landscape is changed, appearing as a gently undulating tableland covered with grass or stunted heather, or, where peat-moss has in past times formed and deeply covered the rocks, with crowberry, heather, cotton-sedge, and poor grasses. The greywacke, which is the chief rock of these hills, forms a good soil for grasses, being moderately rich in mineral salts and retentive of moisture.

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Where it crops out on the surface and weathers openly, an association of rich grasses can usually be observed. Ewe hill [1521 feet (462 metres)], in the Cloich range, may be taken as a type of the whole. It is a green hill, with much good pasture, especially on the steep slopes where the rock is near the surface, and in well-drained hollows. On the upper ridges and ill-drained areas, *Nardus stricta* and *Molinia varia* largely replace the better grasses; these parts are naturally avoided by the sheep. On the lower and drier slopes there is a certain admixture of heather with the grasses, but never in the same abundance as in the true heather association. The following list taken from one of the largest patches of heather shows the species most abundant on the slopes:—

Calluna Erica, DC.	Chief Species.	*Pimpinella Saxifraga*, L.
Agrostis spp.		*Galium saxatile*, L.
Festuca ovina, L.		*Vaccinium Myrtillus*, L.
Anthoxanthum odoratum, L.		*Thymus Serpyllum*, Fr.
Helianthemum Chamæcistus, Mill.		*Salix repens*, L.
Lathyrus montanus, Bernh.		*Pteris aquilina*, L.
Potentilla silvestris, Neck.		

It will be observed that although the heather is here the conspicuous species, yet the association as a whole is sharply distinguished from that of the true heather-moor by the abundant admixture of typical pasture species.

3. The hill pasture of the Pentlands is in many parts semi-artificial, as a result of drainage and partial cultivation, and only that on some of the eastern and southern hills can be regarded as quite natural. Over a great part of the northern slopes the subsoil is of boulder-clay, and the ground only slightly inclined and often very moist. The pasture here is often of poor quality, and merges into the heather-moor or even the *Sphagnum*-moor. Constant attention is necessary to prevent relapse to the original condition, examples of which are only too evident. One part, which had been formerly under cultivation, presents this association, which tells the tale of degeneration:—

Dominant grasses—*Agrostis vulgaris*, With., and *Holcus lanatus*, L.
Field pasture plants—*Ranunculus repens*, L. (indicative of moisture), and *Trifolium repens*, L.
Hill pasture plants—*Galium saxatile*, L., and *Campanula rotundifolia*, L. (a few examples only).
Marsh plants—*Juncus conglomeratus*, L., and *J. acutiflorus*, Ehrh.
Peat-forming mosses—*Polytrichum commune*, L., and *Hylocomium squarrosum*, L.
Peat plants—*Calluna Erica*, DC. (here and there), *Potentilla silvestris*, Neck., and *Nardus stricta*, L. (in patches).

Another case of similar retrogression has approached very near to the condition of the *Sphagnum*-moor, for in addition to the peat plants mentioned above, it includes *Sphagnum* spp., *Erica Tetralix*, L., *Molinia varia*, Schrank., *Empetrum nigrum*, L., and *Juncus squarrosus*, L.

Yet it is on this northern slope that one of the finest patches of pasture occurs. This is over a small outcrop of limestone in the vicinity

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of Bavelaw. There the grasses were so closely grazed by sheep and rabbits that it was impossible to prepare a satisfactory list of the species.

The pasture of the southern slopes of the Pentlands is drier and less dependent upon human control. The rocks of the eastern part, at least, are andesitic, forming a dry crumbling surface soil, fairly rich in mineral salts and resembling the soil of the basaltic hills. Correlated with this similarity of soil there is similarity of flora. Turnhouse hill furnishes a good example of this type.

The complete list of the hill pasture plants found on the Pentlands is considerable, including about 120 species. It would extend this paper greatly to add it here, and, besides, it may with little trouble be constructed from the floras by Balfour (1) and Sonntag (22).

Mixtures of Pasture and Heather.

On the map it will be seen that much of the pasture colour has been dotted over with the heather colour. This convention has been used to indicate a mixture of the two associations. In most cases this mixture is developed on wet soils, intermediate in character between the poor soils of the heather-moor and rich soils of the better pastures. It is particularly well developed on the northern slopes of the hills where the inclination does not allow of good drainage, and the soil is almost entirely composed of boulder clay. A similar association has also been formed over parts of some of the old peat bogs, which have been more or less carefully drained and used as sheep pasture.

The following list, taken on the slopes near Listonshiels, will give an idea of the mixed composition of this wet pasture and heath association :—

A. Pasture Plants.	B. Plants of Marshy Places.	C. Peat Plants.
Grasses—		
Agrostis spp.	*Potentilla palustris*, Scop.	*Potentilla silvestris*, Neck.
Festuca ovina, L.	*Parnassia palustris*, L.	*Calluna Erica*, DC.
Anthoxanthum odoratum, L.	*Scabiosa Succisa*, L.	*Erica Tetralix*, L.
Holcus lanatus, L.	*Achillea Ptarmica*, L.	*Juncus squarrosus*, L.
	Pedicularis sylvatica, L.	*Scirpus cæspitosus*, L.
General List—	*Juncus conglomeratus*, L.	*Molinia varia*, Schrank.
Ranunculus acris, L.	*J. acutiflorus*, Ehrh.	*Nardus stricta*, L.
Trifolium repens, L.	*Carex ovalis*, Good.	*Sphagnum* spp.
Lotus corniculatus, L.	*C. flacca*, Schreb.	*Polytrichum commune*, L.
Potentilla Fragariastrum, Ehrh.	*Deschampsia cæspitosa*, Beauv.	
Galium saxatile, L.	*Sieglingia decumbens*, Bernh.	
Achillea Millefolium, L.		
Cnicus arvensis, Hoffm.	To this, other *Juncus* and *Carex* species might be added.	
Hieracium Pilosella, L.		
Taraxacum officinale, Web.		
Campanula rotundifolia, L.		
Euphrasia officinalis, L.		
Prunella vulgaris, L.		
Plantago lanceolata, L.		
Rumex Acetosa, L.		
Luzula campestris, DC.		

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Within this wet pasture area on the Pentlands are the only recorded stations in Scotland for *Primula farinosa*, L., although the species is probably now extinct there. These stations are near West Linton (1), and on "boggy ground above Woodhouselee" (15). This species and some others, including *Rubus Chamæmorus*, L., and *Saxifraga Hirculus*, L., which have also been or are still found on the Pentlands, are regarded by Warming (27) as relics of the tundra age which existed in North Europe after the melting of the glaciers.

The consideration of the region of hill pasture and moorland has shown that a very close relationship exists between the vegetation and the subjacent soil. To the careful field observer, every change in surface geology is found to be more or less distinctly indicated by the superposed vegetation. Detailed soil maps are still wanting of this region, but from the many correspondences which can be noticed in the field, they ought, when formed, to show a marked resemblance to the vegetation map. On the published geological maps, only the solid rocks are represented, while the superficial glacial deposits which cover most of the area are quite omitted. Thus comparison between these maps and the vegetation map can only be made where such superficial deposits are absent. In the various examples which have been given above of particular heather or grass associations covering hills of particular rocks, considerable trouble has been taken to make sure that it is the solid rock and not the glacial drift which has given rise to the soil.

Junction of pasture and heather on the north slopes of Black Hill, Pentland Hills. (The heather is the darker in shade.)

Through the kindness of Mr. B. N. Peach and Mr. John Horne of the Geological Survey, I have been enabled to compare my map with the manuscript drift maps at the office of the Survey.[1] A very distinct correspondence can be traced between the two, especially in those parts

[1] I have also to acknowledge my great indebtedness to Mr. J. G. Goodchild of the Geological Survey for much friendly help regarding these geological questions.

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where islands of solid rock stand out from amongst drift of a different nature. Thus, for example, the lines bounding the heather area on the Black hill almost accurately represent the edge of the drift covering the lower part of the hill. The same thing is even more strikingly observable on the Cairn hills, where on both the north and south sides the limiting line of the heather area follows for some miles the limits of the sandstone rocks free from drift.

Sometimes peat constitutes the superficial deposit which separates the vegetation from the influence of the subjacent rock. Thus at Cobinshaw a considerable amount of limestone occurs, which, if on the surface, might be expected to be covered with good pasture, but which is buried under peat, and only bears a poor vegetation of the heather-moor and *Sphagnum*-moor associations. A similar state of affairs has already been mentioned for the tableland of the Moorfoot hills, where the Silurian rocks are deeply covered by peat, and thus the superposed vegetation is of the heather type rather than of the grass type.

These questions dealing with the relationship between the vegetation and the subjacent rock will be further considered with succeeding sheets of the map.

On a map of larger scale, it would be possible to represent the distribution of certain other species which are indicative of particular conditions. Thus, for example, the whin or gorse (*Ulex europæus*) and the bracken (*Pteris aquilina*), which have been already mentioned as characteristic of the basaltic and andesitic hills, are much better developed on the sunny, dry, southern aspect of the Pentlands than on the ill-drained northern slopes. The upper limits of their areas of distribution differ accordingly. Thus the whin ceases between 600 and 800 feet (182 and 243 metres) on the north slopes, while on the south slopes it in some places passes 1000 feet (304 metres); similarly, the upper limit of the bracken is rarely beyond 1250 feet (380 metres) on the north, and frequently reaches 1500 feet (456 metres) on the south. The bell heath (*Erica cinerea*) also tends to be more abundant with a southern exposure; this can be easily observed by comparing the north and south slopes of Carnethie hill. The mountain buckler fern (*Lastræa Oreopteris*) indicates definite conditions of exposure, as it hardly develops to any extent elsewhere than on steep, well-drained slopes, which are rarely touched by sunlight, as for example beside Logan Lee waterfall.

The hill region has not escaped human influence, and sheep-raising and grouse-preserving have had their effect on the vegetation. The regular grazing, manuring, and treading of the sheep tend to promote the growth of grasses, whilst on the other hand the regular burning of the heather, on certain soils at least, strengthens that species. Thus the natural relations of the species towards each other tend to be altered. Sometimes the changes induced are considerable, but as a rule they seem rather to be in the direction of emphasising the original contrast between the two associations; for it is the naturally good pasture which tends to be improved, and the natural heather area which is chosen as a grouse-preserve. This subject, however, along with the relationship

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between the soil and the vegetation, must be discussed with reference to other districts before satisfactory conclusions can be drawn.

The vegetation of the Pentland area must have changed to a certain degree with the extension of the drains which supply the numerous reservoirs amongst the hills. Many minor changes of recent date can indeed be observed in the marshes, where dry pasture or heath has succeeded rushes or *Sphagnum*. Since the human influence is steadily growing stronger from year to year, more changes may be anticipated. It is then hoped that, as this map ceases to be a representation of the actual aspect of the vegetation, it may acquire a new interest from the historical point of view.

Alpine Region.

The hills in the present sheet do not quite reach the alpine region. Yet a few species having some claim to be considered as alpine are found in isolated stations, indicating an approach to that region. These are probably to be regarded as the remnants of a richer alpine flora, which has slowly been driven back and exterminated by the inroads of species more exactly adapted to the life-conditions. The following are the species which have been recorded :—

Rubus Chamæmorus, L.—In a small peat bog beside the "borestane" on East Cairn hill.

Saxifraga oppositifolia, L.—Allermuir Burn (1). [Not given by Trail (26) for Midlothian, and probably extinct.]

S. Hirculus, L.—Already mentioned in connection with the *Sphagnum*-moor association.

S. aizoides, L.—Pentland hills. [Sonntag (22) only, not given for Midlothian or adjacent counties by Trail (26).]

S. hypnoides, L.—At Logan Lee waterfall, etc.

Sedum roseum, Scop.—On wet rocks, Pentlands (1).

S. villosum, L.—In subalpine marshes, *e.g.* near Harper Rig.

Meum Athamanticum, Jacq.—This species, characteristic of many subalpine pastures, is only recorded from Penicuik (1).

Oxyria digyna, Hill.—Only recorded by Sonntag (22).

Poa alpina, L.—Only recorded by Sonntag (22).

In conclusion, I beg to express my deep sense of gratitude for the aid that I have received from numerous specialists in the sciences related to the work of this survey. I have in particular to acknowledge my great indebtedness to Mr. J. G. Bartholomew, who has not only taken much trouble in the reproduction of the maps, but has in addition given me much invaluable advice regarding methods of survey and of cartographic representation.

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The above paper was read at the Society's rooms on May 10th; Sir John Murray, K.C.B., in the Chair. After Mr. Robert Smith's lecture, Mr. PEACH expressed the pleasure with which he had listened to Mr. Smith's interesting address, and called attention to the importance of his observations as forming the first instalment of a Botanical Survey of the whole of Scotland. He had had the opportunity of examining some of Mr. Smith's botanical maps in the office of the Geological Survey while he was carrying on his investigations in the Midlothian district. Mr. Peach was struck with the remarkable coincidence of lines drawn by Mr. Smith between different plant zones and certain geological boundary lines laid down upon the Survey maps. This seemed to show that there is a direct relation between the distribution of rock formations and plant life. Mr. Peach then proceeded to give certain illustrations of the phenomena as shown upon Mr. Smith's map. He called attention to the fact that the finest wheat-growing ground in Scotland is coincident with the area occupied by the heavy carse-clays of the various ancient raised beaches which fringe our coast. The pasture-covered area, in the Breadalbane Hills, which, according to the botanical map, forms such a marked contrast with the heather-covered zone to the north, is due to the existence of a belt of calcareous schist and limestone which are there well developed; while, to the north, there is a broad area of siliceous schist which affords little or no nourishment for grasses. In like manner, the pasture-covered slopes of the Ochil Hills are due to the disintegration of andesitic lavas and ashes rich in silicites of lime and magnesia, which are converted into carbonates under the influence of the weather, forming a rich soil at high altitudes.

The Pentland Hills, in many respects, resemble the Ochils in geological structure and in the distribution of the plants. The botanical map, however, shows two isolated heather-covered areas which were specially referred to by Mr. Smith. One of these—the Black Hill—is composed of an intrusive acid igneous rock, while the other is co-extensive with the Cairn Hills, which are made up of siliceous sandstones of Upper Old Red Sandstone age, both types of rock being unsuitable for the growth of grasses.

The pasture-covered area of Patie's Hill, near Carlops, also specially referred to by Mr. Smith, is due partly to the development of the Lower Old Red conglomerate, made up of greywacke pebbles from the Silurian rocks of Southern Uplands which are pasture-bearing, and partly to andesitic lava-sheets which form the slope overlooking Carlops.

Colonel BAILEY said that Mr. Smith's excellent maps should prove of considerable value to landowners, in connection with the formation of new plantations; as regards existing crops, however, it would not be forgotten that, with rare exceptions, these were not of spontaneous origin, and this fact would detract, to some extent, from the value of the maps, so far as their indication of species-zones

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is concerned. Referring to what Mr. Smith had said as to the distances from the parent trees at which naturally sown seedlings of the various species are to be found, he observed that, apart from the weight of the seed and the existence or otherwise of an attached "wing," the distance was largely a question of situation and the lie of the ground, as well as of the force and direction of the wind at the time of dispersal of the seed. For example, seed-bearing trees standing on a high ridge, with low ground on its leeward side, might give rise to seedlings springing up at very long distances, if the wind were strong at the critical time. Again, much would depend on the nature and condition of the soil on which the seed might fall, and on the character and density of the vegetation through which the seedlings must attempt to force their way. Hence it was very difficult to arrive at correct figures; and this difficulty was increased by the fact that many naturally-produced young plants owe their origin to seeds carried and dropped by birds or other animals, so that it was frequently impossible to determine the origin of seedlings found at a distance from seed-bearing trees. He mentioned instances illustrating these points, and observed that in parts of Ross-shire natural seedlings of the light-loving larch and Scots pine come up freely in the tallest heather, while they are rarely found among intervening patches of much lower grass.

Sir JOHN MURRAY commended the excellent character of the work of the lecturer, and described various plant-associations observed during the survey of the Scottish Lochs.

THE GERMAN DEEP SEA EXPEDITION ON THE SHIP "VALDIVIA."

ON the 1st of August 1898 the German Deep Sea Expedition, under the leadership of Professor Carl Chun of Leipsig, left Hamburg in the *Valdivia*. The *Valdivia* is a vessel of 2600 tons and 1250 horse-power, and was completely fitted out with provisions, crew, laboratories, etc., by the Hamburg-American Company, who were sufficiently patriotic to do so for £17,000, a sum which merely covered the expenses, and left no profit for the company itself. Captain Adalbert Krech, formerly a whaling captain, was in command. The scientific staff consisted of Professor W. Schimper of Bonn, botanist; Drs. Karl Apstein, Ernst Vanhöffen, and Fritz Braem, zoologists; Dr. Gerhard Schott of the Deutsche See Warte, oceanographer; Dr. Paul Schmidt, chemist; Herr Sachse of the Hamburg-American Line, navigator, and Dr. M. Bathman, medical officer and bacteriologist, who unfortunately died while the expedition was in the Indian Ocean. Dr. August Brauer and Dr. Otto L. zur Strassen, zoologists, and Herr F. Winter, draughtsman and photographer, also sailed with the expedition, but had no official status.

The first port of call was Granton. Here the expedition was entertained by Sir John Murray and visited the office of the *Challenger* Expedition Commission. The *Valdivia* then sailed northward past the Shetlands, almost to the Faeroes, and then headed southward to the west of the British Isles to the Canary Islands. Entering the Gulf of Guinea, a brief stay was made at Victoria and the Cameroons, as well as Banana at the mouth of the Congo, and Great Fish Bay. Cape Town was reached on the 26th of August, and after staying some days there, the expedition

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cruised along the south coast of Africa as far as Port Elizabeth and back again at a greater distance from the land in order to study the physical conditions of the Agulhas current. Final departure from Cape Town was made on November 13th, and a course steered for the uncertain Bouvet Island. The first large iceberg was sighted at about midday on 25th November, and later on the same afternoon, during stormy weather and fog and amidst icebergs, Bouvet Island was sighted and its position determined. Thereafter the *Valdivia* sailed in an ESE. direction for 50° of long. along the edge of the Antarctic pack-ice, attaining a lat. of 64° 14·3′ S. in long. 54° 31·4′ E. to about a hundred miles to the north of Enderby and Kemp Land. After this visit to the outskirts of the Antarctic regions a more or less north-easterly course was steered towards and into the Indian Ocean—Kerguelen, St. Paul, and New Amsterdam and Cocos Islands were visited, the expedition thereafter making the Sumatra coast at Benkolen, and working along it and past it almost to the Andaman Islands. A few days were spent at Colombo, and on the 16th of February a southerly course was steered from Ceylon for the Chagos Archipelago. The *Valdivia* then went eastward to Zanzibar, passing the Seychelle Islands, and worked northward along the coast of Africa, rounding Cape Gardafui, and, returning homeward by the Red Sea and Mediterranean, reached Hamburg on the 30th of April.

Observations and collections were made at 274 stations. The farthest north station was off Suderö, the southernmost island of the Faeroes, in lat. 61° 30′ N., long. 7° 00′ W., and the farthest south station a hundred miles north of Enderby Land in lat. 64° 14·3′ S., long. 54° 37·4′ E. One hundred and eighty-six soundings were made in depths varying from 46 fathoms in the North Sea to 3232 fathoms in lat. 18° 17·6′ S., long. 96° 19·8′ E., immediately south of the Cocos Islands. The soundings of greatest interest are undoubtedly the series taken whilst cruising along the edge of the Antarctic pack-ice, from Bouvet Island to Enderby Land. Excluding one in the vicinity of Bouvet Island itself, the least depth was 2205, while the greatest depth was 3135 fathoms, only slightly less than the two deepest soundings taken, viz., two to the south of the Cocos Islands. Considerable doubt has been thrown on the sounding of 4000 fathoms, no bottom, taken by Sir James Ross to the SW. of Bouvet Island in lat. 68° 34′ S., long. 12° 49′ W. in 1843. But these records of soundings of 3000 fathoms and more taken by Professor Chun and Captain Krech surely indicate that Ross was probably correct. It will be an interesting point for the coming German or Scottish Antarctic Expedition to make a point of steering for Ross's position and verifying or contradicting their predecessor's observation, and to connect it by one or more lines of soundings taken by the late German Deep Sea Expedition.

Off Enderby Land the sea showed a fall of temperature from 30·1° F. to 29·0° F. from the surface to 41 fathoms. A rapid rise of temperature then took place until a maximum of 35·0° F. was reached in 165 fathoms and maintained fairly constantly to a depth of 825 fathoms, although it was slightly lower at 330 fathoms, viz., 34·1° F.; below 800 fathoms there was another fall, the thermometer registering 30·9° F. at the

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bottom, viz., 2570 fathoms. These closely agree with temperatures taken by Mr. W. S. Bruce in 1892 and 1893 to the E. and NE. of Graham's Land. Mr. Bruce's observations showed a lower temperature between 50 and 120 fathoms than the surface, but a considerable rise of temperature when 300 fathoms was reached. It is interesting to compare these temperature observations, since up to this time these two expeditions were the only ones which had used the reversing thermometers in the Antarctic Regions.[1] Between the Cameroons and Saint Thomas on the equator the surface-temperature was 77° F., and fell rapidly to 59° F. in 55 fathoms. A more gradual fall of temperature then took place until 40° F. was registered in 550 fathoms; the temperature remained practically uniform after this depth, 37·5 being recorded at the bottom, viz., 2741. The temperature Chun obtained in the Antarctic at this depth was 32·0° F. Between Nias Island and the west coast of Sumatra similar results were obtained, except that the surface-temperature was higher, and that a more rapid fall of temperature took place between 50 and 100 fathoms. The temperatures throughout were about 5° to 9° higher than those taken off the Cameroons.

Bouvet Island was placed in 54° 26·4′ S., 3° 24·2′ E. This places the island farther west than it is in the British Admiralty charts, and appears to disprove the existence of the several other islands charted in its neighbourhood, since the *Valdivia* sailed over or near their assigned positions. Its greatest breadth is 5·1 nautical miles east and west, whilst north and south it is 4·3 miles across. "It is entirely covered with glacier ice, is steep and inaccessible. Apparently it consists of a volcanic cone with a broad crater edge." Basalts and tuffs were found in the dredge in its vicinity. Kaiser Wilhelm Peak was estimated to be 3080 feet, the same height as previously recorded in the British Admiralty charts. For detailed accounts of biological, meteorological, and other work of this description, we must refer the reader to Professor Chun's, Dr. Schott's, and Captain Sachse's accounts in *Die Deutsche Tiefsee Expedition auf dem Schiff "Valdivia" 1898 to 1899*, *Internationaler Geographen-Kongress Berlin* 1899.

THE CHACO BOREAL: THE LAND AND ITS PEOPLE.

By W. Barbrooke Grubb,

Superintendent of the Paraguayan Chaco Mission of the South American Missionary Society; "Comisario General del Chaco y Pacificadon de los Indios."

(*Read at the Society's Hall, January* 18, 1900.)

The Chaco Boreal and its people is a subject about which practically nothing is known. I have spent eleven years in that region, and have consequently a fairly good general knowledge of it. I trust, therefore,

[1] *Geog. Journal*, vol. vii. No. 5, May 1896, "Cruise of the *Balæna* to Antarctic Seas, 1892-93." By William S. Bruce.

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that you will bear patiently with me while I try to impart what I know about the subject in question.

Map.—Allow me before proceeding further to refer you to this map for a few moments.

Boundaries.—The Chaco Boreal is bounded on the S. and SW. by the river Pilcomayo, on the W. and N. by Bolivia and Brazil along the the parallel 22° S. latitude, and on the E. by the river Paraguay.

Area.—The area is computed to be 72,000 square miles. The whole of this vast tract is almost a dead level, any slight elevation towards the higher lands of southern and eastern Bolivia being almost imperceptible. I believe that the elevation above sea-level varies from 400 to 600 feet only.

General Features of the Country.—The northern Chaco is, as I have just said, a dead level plain. The soil is clay, but in the woods the clay is overlaid by a deposit of vegetable mould varying in thickness from an inch to a foot, or even 15 inches in places. This is general throughout the whole country.

From the Paraguay westwards for about 120 miles palm forests—of the Carandai or fan-leaved palm—form a striking peculiarity of the scenery. There are millions of these palms, and in places they stretch uninterruptedly for miles. Tall and fairly straight, these trees often attain a height of 60 feet, and sometimes 70 or even more, although I think 45 feet about the average.

Owing to the level character of the country and the clayey soil, which retains the rain-water for a considerable time, swamps abound, sometimes of great extent, covering many square miles. These swamps are simply inundated country, with a dense growth of "estera" and other water-plants and reeds; they are not bogs, and are quite safe to cross, the bottom being comparatively hard. To cross such places on foot or horseback, although not dangerous as in the case of treacherous morasses, is sufficiently slow and tiring. It is simply a case of painfully splashing, slipping, and every now and then sticking in the mud. When half-dry, the mud being more tenacious, these swampy plains are still more difficult to traverse. To cross such places with a cart or waggon requires the strength of Samson and the patience of Job; a cart with a load of half a ton and ten bullocks can hardly move. The drivers on foot of course look like mud eels, fall and slip about like drunken men in the green, slimy, oftentimes evil-smelling mud, and men and animals are nearly consumed by the myriads of flies and mosquitos which infest such places. These swamps are in reality swamp streams—that is, they are natural hollows running with varying breadth and intersecting the whole country, often connected directly or indirectly with the rivers, and so act as great drains. The country being so flat, and consequently so little watershed, the flooded rivers discharge into the swamp channels, and they in turn get rid of the water by very slow drainage and by much more rapid evaporation.

The Chaco is subject to great extremes of drought and flood. The climate in times of flood is hot and murky. On the whole, however, the floods are preferable to the extreme droughts, and the poverty of the

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Chaco lies in want of sufficient permanent fresh water—not in its periodic floods. Life, it is true, is more agreeable in the dry years, as there is less mud, less oppressive heat, less sickness, fewer insects. Still, it is hard to choose, for if mosquitos abound, owing to the water, fleas do not; but if dry there are fewer mosquitos and more fleas and jiggers: both are equally bad.

These swamps are full of swamp-fish and eels, especially the famous mud-fish, (the "Lolock" *Lepidosiren paradoxa*) and in some of the deeper streams alligators are found. When the floods subside the stench from these swamps is almost unbearable, and flies swarm in millions, making the plague of Egypt a mere trifle in comparison.

Rivers.—The chief river is the Pilcomayo. Besides this river, which has attracted much attention for 300 years past, and the true course of which has not yet been discovered, there are the Monte Lindo and Rio Verde—which I have explored for some hundreds of miles by their courses,—the Compus, and several other smaller streams; most of these are brackish, and in low-water in the central part of their course quite salt. These rivers are practically valueless for navigation by reason of the banks, snags, tortuous course, and uncertain water supply. The banks are often wooded and fairly high, but behind the banks the land often dips again. Many little streams fall into them. The adjacent country is subject to floods. The presence of salt I attribute to the water running through a salt stratum which is very general in the Chaco Boreal.

Beyond the limit of 40 *or* 45 *leagues W. the whole country changes.* Palms cease, the country becomes park-like, forests when met with are of greater extent and larger timber. The swamps are smaller and water generally scarcer, the grass is poorer; but farther towards the head-waters, and nearer therefore to the *Pilcomayo*, the country again improves, and a better supply of water is obtainable.

In the western portion the inhabitants are more than ever dependent on tanks in which to conserve the rain-water and collect the drainage. In extremities they collect water from a large root called *annil.*

In 1890 I ascended as far as possible the Rio Verde by steam launch. I only reached a point of about 15 miles due west, but by water it was over 60. The Rio Verde was low at the time, and full of snags and banks; fresh water was difficult to find; and after hard work and the usual discomforts I had to put back for fear lest my boat would become stranded for want of water.

In the same year a companion ascended the Monte Irrido with an engineer, Don Pedro Freund, reaching a point about 63 miles due west, or roughly 230 by river. In 1892 I ascended the Monte Irrido for about 350 miles by water, and had to return for want of water, the river falling rapidly.

I regret that, from want of instruments, I can only give rough calculations.

It has been by land, however, that we have learned most about these two rivers. I believe, and the Indians confirm the belief, that these two streams are branches of the Pilcomayo. They flow generally from NW.

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to SE., and are each about 700 miles long. They are extremely tortuous, full of snags and banks, often blocked by rafts of drift-wood which entail immense labour to cut through. These rivers change their courses often, and to a great extent owing to the nature of the country. They flood easily, and at times of drought are almost dry. I have known within a few days the Rio Verde rise from 6 inches to 10 feet, and in a few weeks to sink in like manner. They both run through saline country, and the water is brackish at high-water, and salt as the sea at low-water. They are useless for navigation or rafting timber. In flood time there is water, but drift-timber blocks the way. In low-water navigation is impossible. Near the river Paraguay, to a distance of 60 miles due west, the Monte Irrido could be utilised a little for small craft, and the water is, although not very nice, yet drinkable; but the tortuous channel and the liability to flood are serious drawbacks. The Rio Verde is useless beyond a point 12 miles due west. We have given great attention to these two rivers, if haply we might have been able to use them as a highway, but we have found that the slow bullock-cart is the best mode of transport, after all.

The land for 10 leagues back from the Paraguay is very rich in grass, and generally fairly well watered, with palms and timber; even a little agriculture might be carried on. Inland from this, permanent water becomes scarce.

For 30 leagues from the river Paraguay the land is low and the grasses good. Beyond that limit the grasses get somewhat poorer.

There are four distinct elevations in this region. In the swamp level—the actual swamp—the "estera," bulrush, and pegatva are found. On the outer circle the costadera or swamp-grass—a strong cutting grass, useful only, as far as I know, for thatching purposes, for which it is excellent.

Second elevation—the *tasaru* plains—good grassy plains, treeless; and except for an occasional Puktim tree, and a few poor fan-palms, these plains are covered by the ant-hills called *tacuru*, are subject to floods, often lying for long periods under water 6 inches to 1 foot 6—terrible plains to cross by cart or horse, or even on foot, in wet weather, on account of the mud.

In the dry season—no water is to be got on these plains—snail shells are found in heaps, and coals of a small kind are often crushed by the passing foot. The grass is rank, but good when recently burnt. Deer and ostriches frequent these plains when the grass is low. When the grass is long and toughest these plains are almost impassable.

The palm (*Fan Palm, Carandai*) zone is the third in elevation. Palm forests are very extensive—white, black, and red are found, so called from the colour of the wood. The black are the only ones of value for export or building—all our building is done with them, and even doors and furniture are made by cutting them into laths: also we make palm tiles for roofing. The cabbage forms a great part of the Indian food, and is not bad. The grass is good: flooded state is generally only a few inches.

The highest belt of all is the wood or forest belt. This land is never flooded. The trees are not of any great size, the largest being

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Quebracho and *Algarobo.* A great deal of thorny *scrub* lies near the ground, forming a tangle so dense that a road has to be cut with the machaton or bush-knife.

The principal trees are *Quebracho,* red and white; *Algarobo* of three kinds, giving a good nutritious bean used by the Indians for bread, and also beer: also it is excellent food for cattle and horses, and is much sought after by pigs, etc. *Palosanto* and Satin-wood are also found. *Cacti* and "Karaguata ü" abound, and cochineal is met with. Great quantities of honey are found in these woods.

The soil is vegetable mould, but not very rich; nevertheless it produces sweet potatoes, pumpkins, maize, beans, manioc, "cultiyi," etc. Sugar-cane, tobacco, and cotton grow fairly well.

These forest lands fit for cultivation are of no great extent, and agriculture is hindered by ants, locusts, and other insects, and by droughts.

Bananas and oranges suffer from the salt in the soil. Cotton might grow well.

As an industry, beyond home wants, the Chaco in this part is useless from an agricultural point of view.

Transport is so difficult and would be so expensive that no profit could accrue.

Cutting and exporting timber is unprofitable, because no water-ways or good means of transit exist, and wood of marketable kinds is not found in sufficient quantity in any one locality.

The only fresh-water supplies in the country are in the swamps which collect the rains, and the swamp streams which derive their supply from drainage of the surrounding country, and to a certain extent from rain which falls from the Bolivian portion of the Chaco, and the overflowing of the fresh-water streams at the headwaters of the Pilcomayo. But these supplies are precarious, and depend on the rainfall. Lakes properly so called do not exist.

The swamps are sometimes of great extent, covering many square miles of surface. The swamp streams are in width from a few yards to half a league, and vary in depth when the water is full from a foot to 10 feet, but both swamp and swamp streams dry up into little pools of foul water during a protracted drought.

The natives makes wells or rather tanks, holes about 10 feet deep: beyond 13 or 14 feet silt sand is generally met with. The water is (when present in any quantity) salt. Further boring is prevented by the silt sand, which seethes up, and the well becoming undermined falls in. Natural hollows cut out and banked conserve water for a certain period: swamp streams dammed do the same on a larger scale. But evaporation is great, and in time they dry up; and during floods the dams give way and are continually ruined by insects and other burrowing animals.

Want of permanent water is the curse of this part of the Chaco, and generally of the whole region.

Climate.—The temperature is—average, 75°; extreme heat, 110° Fahr.; extreme cold, freezing point: but that is very seldom.

The seasons are not very reliable. Generally speaking, the rains begin in December and last till end of April, but I have known dry

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seasons in these months, and wet seasons in August, generally a dry time.

Indians of the Chaco Paraguayo.—The Indians of the Paraguayan Chaco are of two distinct families—the Lenguas and the Suhin. These are again divided into several tribes—the Mascoi, Lengua, Angaitè, Sanapanas, Toòthli, and others. These tribes are again subdivided into smaller tribes—Kyonnawatsum, river people, and so on; and these smaller tribes are yet again subdivided into many clans. The clan averages fifty to seventy persons, taking the whole country; in some parts it is less, in others greater.

The Lenguas are monogamists. The Suhin are polygamists. Polyandry is known, but not to any extent.

These tribes have no central government; they recognise no supreme head. The smaller tribes, composed of five or six clans, hang together more or less, are entertained by one another at feasts, and are more or less united by common ties. Each clan has a chief, not hereditary by law, nor elected by law, but some man who has the power of attaching and keeping the clansmen together; but at best very little power accompanies the office of chieftain. The clan government is like our own, ruled by popular opinion. No chief would think of taking any steps unsupported by popular vote. The witch-doctor represents the "Church," and his power is, though not beloved, very great and real.

He can, so the Indians believe, inflict calamities, or save from them. He can cause cats, beetles, creatures of all kinds, in spirit form to enter his enemy, or he can extract them from his friend.

Every clan has at least one fully qualified witch-doctor, and some students studying the profession.

In some respects every man does just what seems good in his own eyes, but as they cannot exist quite independently of each other, they have many traditional laws framed for the general good, or what is supposed to be for the general good; and these traditional laws are strongly upheld and enforced by public opinion.

A few examples will illustrate this. Visitors, especially relatives, must receive food. Visitors are many; many relatives are of the "sundowner" class, or to use a term perhaps better understood, they are "spongers."

Custom teaches hospitality, but in order to have the wherewithal to give, such as produce of the garden and the chase, work is necessary. Now the Indian argues, Why work to keep a lot of lazy loafers? Better take it easy and work little, and then the claims of hospitality will be less, because we have little to give. We will be quite as well liked by our neighbours and have a much easier life.

Many of the Indians would be fairly hard workers, but they know that a large number are loafers, and the more they worked and got, the more poor relations would crowd round them, and, while praising them for their industry and hospitality, sit quietly by and eat the produce as it comes in.

This is the cancer that eats at the root of the industrial life of the people.

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The Indian has not the moral courage to say to his friends, "If a man will not work neither shall he eat."

The Indian's food is fish, game, and simple crops, badly and dirtily cooked. These simple things can be got without much labour, and with this the people seem content; but it is not so. The Indian can grow a great deal more and a greater variety of food stuffs; he has the knowledge, but not the will.

He can cook fairly well—as we have proved—but he does not take the least pains with his own cooking.

He can build a house—a good neat cottage—but he is content with a mere booth of sticks and grass.

He can trade; he could keep cattle. He does neither.

Why all this indifference to comfort? Why this disinclination to advance? I can give three main reasons.

The first I have already mentioned. Many are spongers.

If a man builds a nice hut, others wait, look on, then crowd in and share it with him.

If he plants plenty and lays up a store of good food, spongers will not work till that store is consumed. He has plenty; why should they trouble?

If he cooks nicely, tastily, and well, all enjoy it, and come to eat it. He gets no benefit from his exertions but the doubtful one of extra hard work and many cupboard friends. Now there is good material in these people. This sponging way and these lazy habits are the product of long years and generations of custom.

Many are quite willing to advance could they eat in peace with their families the fruits of their labour. They have not, however, the moral courage to refuse help to the spongers. For obvious reasons. They have no leader—no one man head and shoulders above his fellows to come out and rule.

They need protection from enemies, and gladly suffer the loafers for the sake of their help in case of attack. And again, in such a land, a dreary lone land, sparsely populated, and with their innate fear of ghosts, devils, etc., they need company; and loafers give that. So long as no one works too much or does more than supply momentary wants, equality and justice reign. The worker cannot crush the idlers, cannot raise them, and so they are content to sink to a common level.

If socialists would go and live in the Chaco for a year, they would never talk socialism again. Fifty per cent. of mankind will loaf if they can, and prey upon the workers and the brains of the nations; and such loafers must be kept to the wheel and ruled by the brains and arms of the industrious, else the world will sink back into savagery.

What the Chaco needs is men to rule and make government, and give security of property.

The industrious Indians will flock round and support one who can show them how to advance, live in more comfort, and get free of their sponging relations.

The industriously inclined are few, but the number would soon increase. New wants must be created, and when such become neces-

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saries of life, the people will work to get them, and the habit of industry will grow. If an Indian wants an axe, he will work for that axe—to make him industrious, therefore, teach him to have many wants. Were it not necessity there would be many of our own people quite as lazy as the Indian. Generations of industrious habit, however, tell powerfully in our case, and doubtless would tell in time with the Indian.

A few more remarks about this interesting people may be interesting to you. They are, and have always been, practically independent and beyond the authority of the Spanish-American Republics which claim their territories. They are regarded by the government as outlaws; their destruction is regarded as necessary and desirable in the interests of these states. No properly planned or persevering effort has been made to reduce them to a civilised condition. Yet in these native races we have the raw material out of which a people might be made who, better than any others in South America, could develop these tropical and by no means over-healthy regions, bringing wealth, power, and strength to the ruling states, under whose nominal authority they are. An attempt is now being made to Christianise and develop these native races by the South American Missionary Society and the friends of the aborigines.

The natives are well-built and strong and healthy—disease is unknown among them. They average 5 feet 7 inches in height, and their chest measurement is 36 inches.

Their women are well treated, and confine their energies to housework and nursing. Though not a warlike people, they can be quite troublesome enough when roused, as past history can tell.

They are a mixed aboriginal people, although of pure Indian blood —undoubtedly they have Inca intermixture—and a great variety of types are found, some very dark, some quite fair for Indians, some sharp-featured and intelligent, others heavy-featured and dull; but in general they resemble other South American Indians.

Their account of the Creation is that all things were made by a great beetle, and man and woman like Siamese twins.

Fire was known to a bird first, which cooked its food. Man in those days ate raw food, but one day the man tried the cooked food and found it so good that, watching his opportunity, he stole the fire, and ever since the birds eat raw food, and man cooked food; but the bird in revenge makes thunder and lightning, and so causes destruction by fire.

Their method of obtaining fire is by fire sticks, which they rub till friction produces fire, and then with wild cotton they obtain the light they require.

They are firm believers in dreams, and generally act upon them. Suppose a man dreams I kill him, he considers himself justified in killing me—because he argues thus. The Indian theory is that the soul leaves the body during sleep, and wanders about trying to satisfy its desires. My soul has visited him while he was sleeping and tried to kill him—but being spiritual it could not effect its purpose, not being in the flesh. When rejoined to the body—my body, given a favourable opportunity,

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will try and carry out the desire of my soul. It is therefore intended murder, and in self-defence he slays me if he can.

Souls while thus out wandering during sleep sometimes get captured by evil spirits or disembodied ones, and the man awakes, and states that, as he has dreamed that his soul has been stolen, he must have the help of the witch-doctor to bring it back to him. This is done by singing, chiefly. All diseases are caused by witch-doctors or evil spirits.

Infanticide is very common: about 60 per cent. of the children born die by violence, and a great part of the remainder by exposure and want of care during childhood's first years. Superstition causes a good many of these deaths: girl babies if they precede a boy are put to death; deformed ones also are killed; if the mother or father die at the time of birth the child is killed. The want of a steady and sufficient food supply supports these superstitious customs against natural love. The people are nomadic, because they live by fishing and the chase, and on account of the water supplies, as they have no system of union to aid in making tanks or damming streams. Also they are kept moving from place to place for fear of ghosts. These nomadic habits could all be prevented by management, education, religious training, and time, but in the meantime they make the possession of a large family of little children a great burden, and so the Indians more readily submit to the religious side of infanticide.

The people are fond of the children they keep, and these children are dutiful and kind to their parents. Could infanticide be stopped, the population would rapidly increase. We have tried to settle and elevate these people and to stop infanticide, and we have met with very signal success. A neat orderly village has been built, good gardens made, cattle, sheep, and goats bought and cared for. Infanticide, intemperance—although this is not a crying weakness—and other forms of cruelty and debasement are fast dying out in this particular neighbourhood, and what has been done in this one place could be done doubtless throughout this region.

The religion of the Indians, if such it can be called, is accountable in great measure for the low state of the people.

It is a well-acknowledged fact that the religion of a people has a very great effect upon their life, private and national. The more downtrodden they are by priesthood and superstition, the more wretched and miserable assuredly will be their condition.

The witch-doctor must be paid for all he does, and he grinds the people down.

When a death takes place, native law demands that the village be burned and the property of the deceased destroyed in some way, fear of ghosts being the reason. Under such conditions it could not be expected that the people would build good houses and villages or accumulate property for their children.

Witchcraft here is much the same in principle as in other heathen lands. To rid the people of this superstitious pest, they need a pure, simple religion, none better than the simple, loving, liberal-minded, practical, and life-giving Gospel of our Lord Jesus Christ.

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Freed from superstitious fear, taught to have opinions of their own, to think out matters for themselves instead of trusting all to their priests, who are as benighted, if not more wicked and debased than themselves, taught to be men, and to realise that they were created for a purpose, to make good use of what God has given them, and to glorify Him in all things, they will in due time rise from their present degradation and take the place the Creator intended them to fill. They will multiply in and develop these rich tropical regions, now wilderness, which they inhabit.

The Future of the Country.—It is highly improbable that any minerals will be found in this region, and, as has been already remarked, the country is quite unfit for agriculture on any large scale. Means of transit are so difficult that the expense of export would far exceed the value of the crops raised. *The only possible industry that can be profitably carried on in this country is cattle-raising.*

The country generally, as far as grass-producing power is concerned, would maintain immense herds, but the scarcity of permanent water will always render cattle-raising on a large scale impossible. Building of large tanks would entail a great outlay and great expense to keep them in order.

Were the rainfall, however, to be depended upon, and if the evaporation were not so great, such tanks might be constructed profitably; but the long drought, the precarious rainfall, and extensive evaporation, render dependence upon such reservoirs impracticable. It would be exceedingly dangerous to attempt to maintain a large herd of cattle trusting to reservoir water alone. Permanent water, as I have already said, is exceedingly scarce, and only to be found in certain localities. No cattle-raising could therefore be attempted except where such permanent water was accessible. Large tracts of the Chaco are devoid of such water supply, and therefore perfectly useless; and even where permanent water is to be found it is in such small quantities that only small herds could be maintained. I should consider that a first-class site, of which very few exist, might maintain a herd of 2000, and it would be a very poor locality indeed that could not maintain 100; but the average stock that could be kept at any one place would number from 3 to 500.

It is therefore plain, when we remember that £2 is a good figure for a choice cow, that herds of such small extent would hardly pay an energetic European to spend his life in comparative solitude and with the discomforts inseparable from life in such a region, nor could he profitably manage three or four such farms, because the expense of maintaining a manager and the difficulties of direct supervision would detract too much from the profits.

The maintenance of a European family, dependent as they would be upon a Paraguayan town to supply the necessaries and comforts of life, would entail a considerable expense in transport. *The Chaco is most decidedly unsuitable for European colonisation, except near the main river banks.* Only the lower class of South Americans would be content with the comparatively poor livelihood likely to be obtained in the Chaco,

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and they are not the kind of people likely to venture on settlement in this region.

One thing that has hindered any attempt to occupy and settle the Chaco land has been the fear with which the outside world has always regarded the Indian. This fear has not been and is not unreasonable. The Indians have been anything but pleasant neighbours to the surrounding country for the last three hundred years. This has been greatly the fault of the whites, who have never realised that these natives were capable of becoming valuable citizens, nor have they ever acquired the secret of managing them. They have invariably resorted to force of arms, which has only been partial in its effects, and has served to maintain and stimulate a bitter race hatred. Nor have the whites by any means been very successful in their wars with the Indians. I can safely say that much more white than Indian blood has been spilt, and where the whites have succeeded in crushing the Indians it has only been by superiority in arms and numbers. Tens of thousands of valuable lives have been lost which, under a proper system, might have been spared for the development and enriching of the world. I hold, after fourteen years of continual contact with South American Indians, ten of these having been spent in the Chaco, that the Indians of this region are not only capable of, but by far the most suitable people, to develop the Chaco. The Indian thoroughly knows his country; he is able to derive a great part of his sustenance from the natural products of the land. His wants are much fewer than that of the European, and he therefore could make a handsome living, had he a small herd of cattle, where the European would starve. The native system of working in co-operation is admirably suited to the nature of the country. The Indians would band together and keep their herds in common, each man helping his neighbour.

Could the country be developed by foreign capital, worked by the Indians, a fairly good interest could, I am sure, in due time be paid upon capital thus invested. While the Indians exist (and, as has been often proved, it would be no easy matter to exterminate them, apart from the fact that extermination is contrary to all the best feelings of humanity) they will, if left in their present state, prove an almost insuperable barrier to any successful foreign settlement; whereas, were the Indians of this part encouraged and enabled to profitably occupy the land, they would become good citizens, contributors to the general welfare and wealth of the world, and a settled Indian country would so act upon the surrounding barbarous nations that they in time would follow the good example set by the settled Indian.

It is impossible to tell how far-reaching the effects of such a native civilisation might extend. We know that a great portion of central South America is still in the hands of barbarous peoples. One of the great problems of the future of central South America is the question of a population capable of standing the climate and developing the country. We have, I am certain, in the probable two or three millions of pure Indians, properly managed and sufficiently financed, the secret of this problem.

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This may never be accomplished, but it is our intention and earnest desire to at least try the experiment in the Paraguayan Chaco. A nobler or greater work I can hardly conceive, and I feel proud and thankful at being enabled to bear a small part in the spiritual and temporal advancement of these native races.

Let it be clearly understood that I do not look upon the Indian as by any means a perfect man. A great mistake is often made by kind-hearted people in praising up the innocent savage. He is by no means innocent. But a greater mistake is made by those who think that the Indian is an encumberer of the ground and incapable of development. He is a man, and quite capable of taking his place in the world if properly treated and trained; but it will take time. Let us remember that it took centuries to make the Germans, Russians, and ourselves what we are now. This is a fast-travelling age, and we are apt to expect too much in too short a time. In the Chaco we have very raw material indeed, and it takes a long time for a few men encompassed by so many difficulties of language, race hatred, climate, transport, and finance, to accomplish much. We go to war with the South African Republics; we spend millions and send out thousands of men. We set upon the task of making a country out of a wilderness, and a nation out of some ten thousands of wild, undisciplined savages. To begin with an unknown country, and an unknown people and language, and to accomplish this, all we have is a few men easily counted on the two hands, and a few thousand pounds. Surely with such odds against us we can justly claim plenty of time.

The South American Governments have not always been very kind to the aborigines, but the aborigines have as often been to blame. The governments have failed to do anything with them, and look upon them as a danger to the state, and this with reason: but the reason of the failure to elevate and utilise these native races has been because the right methods have not been taken.

I hold that, pursuing a proper plan, these Indians can be made a civilised, industrious, law-abiding, not to say probably a Christian population.

CONFERENCE OF DELEGATES OF BRITISH GEOGRAPHICAL SOCIETIES.

On May 22, 1900, the Second Meeting of the Conference of Delegates of Geographical Societies of the United Kingdom was held at the House of the Royal Geographical Society.

The following delegates were present:—*Representing the Royal Geographical Society*—Sir Clements Markham, Mr. J. F. Hughes, and Dr. J. S. Keltie. *Representing the Royal Scottish Geographical Society*—Mr. J. G. Bartholomew. *Representing the Tyneside Geographical Institute*—The Duke of Northumberland and Mr. Herbert Shaw. *Representing the Manchester Geographical Society*—Rev. S. A. Steinthal, Mr. E. Sowerbutts, and Mr. E. W. Mellor. *Representing the Liverpool Geographical Society*—Mr. James

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Irvine and Captain Dubois Phillips. *Representing the Southampton Geographical Society*—Colonel D. A. Johnston, Mr. T. G. Rooper, and Mr. W. H. Rogers.

On the motion of the Duke of Northumberland, seconded by Mr. Steinthal, Sir Clements Markham, P.R.G.S., was unanimously voted to the Chair.

Dr. Keltie acted as Secretary.

The Secretary read extracts from the minutes of the preceding meeting.

A letter from the Secretary of the Scottish Geographical Society was read, stating that the Council are of opinion that the meetings of the Conference should be occasional, when any subject of special interest arises which might advantageously be discussed by such a Conference, and that meetings, when necessary, should be held in London.

The Secretary of the Newcastle Geographical Institute wrote, that his Council would welcome occasional meetings in the provinces.

A letter from Mr. Sowerbutts, Secretary of the Manchester Geographical Society, was read, suggesting for discussion—(1) the desirability of asking Government to present to Geographical Societies all reports and papers having relation to geographical and commercial subjects; (2) the formation and maintenance of museums; (3) the position of commercial geography in the new scheme of secondary education.

With regard to (1), it was decided that a letter be written by the President of the R.G.S. requesting Government to present to the Societies Parliamentary papers reltaing to geography.

No decision was come to on the other two points.

With regard to the question of holding annual or occasional meetings of the Conference, it was moved by Captain Phillips and seconded by Mr. Mellor, and adopted unanimously, that there be an annual meeting in London, and that occasional meetings be held when a special demand arises, the Societies being requested to send to the President of the Royal Geographical Society suggested subjects for discussion at the annual meeting not later than the end of April in each year.

For occasional meetings, it was moved by Captain Phillips and seconded by Colonel Johnston, that any Society may inform the President of the R.G.S. of any subject which might deserve discussion, and the President will ask the views of the other Societies.

This was agreed to, and also that the localities of occasional meetings be decided by the opinions of the Societies.

The meeting concluded with a vote of thanks to the Chairman.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

At a meeting of Council held on 11th June, Mr. Nelson Annandale and Mr. Frederic Murray Honey were elected members of the Society.

Mr. J. G. Bartholomew represented the Society at the Conference of Delegates of Geographical Societies of the United Kingdom held in London on 22nd May.

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GEOGRAPHICAL NOTES.

EUROPE.

Railways in European and Asiatic Turkey.—According to *Le Journal de la Chambre de Commerce de Constantinople*, quoting from an official railway publication of 1898, the following list gives the length and gross receipts of the railways in European and Asiatic Turkey :—

Line.	Length. Miles.	Receipts. £
EUROPEAN TURKEY—		
Oriental Railways,	815	459,000
Salonika-Monastir,	137	82,000
Salonika-Constantinople,	317	50,000
ASIATIC TURKEY—		
Anatolia Railway,	634	336,000
Mudaniya-Brusa,	25	10,000
Aidin,	320	23,000
Smyrna-Cassaba,	165	148,000
" " Extension,	157	230,000
Bairut-Damascus-Hauran,	160	78,000
Yafa-Jerusalem,	54	30,000
Mersina-Adana,	42	19,000
Akka-Damascus (under construction),	157	—
Total,	2983	1,465,000

AFRICA.

French Sudan.—According to *La Dépêche Coloniale*, the cost of carriage of a ton of merchandise from St. Louis, Senegal, to the principal commercial centres in the West Sudan is as follows :—

	Per metric ton.			
FROM ST. LOUIS TO—	Franc.	cent.	Sh.	d.
Kayes,	30		24	
Médina,	36		28	9
Dioubéba,	109	50	87	7
Kita,	234	25	187	7
Bamako,	392	72	314	2
Koulikoro,	442	70	354	2
Timbuctoo,	566	45	453	2
Seguiri,	424	22	339	4
Kankan,	445	22	356	2
Kouroussa,	446	72	357	4
Nioro,	267	57	234	1

This list gives the charges for the journey inland ; for the return journey the charge is about one-half.—(*Board of Trade Journal*, 18th January 1900.)

Somali Coast to the Upper Nile.—Dr. Donaldson Smith has arrived in England from his journey of exploration in North-East Africa. He left Berbera on the 1st

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of August 1899, and arrived at Fort Berkeley on the Bahr el Jebel on the 15th of March last. From Berbera he proceeded by way of Hargaisa, Milmil, and the Shabeleh, and arrived at the Juba through the territory of the Afgab. He crossed the Juba at Buntal, and proceeded up the Daua. Leaving the valley of the Daua he passed by way of Egder through the hilly district of the Tertale tableland to the southern end of Lake Stefanie. Thence he proceeded to the northern end of Lake Rudolf and the Omo. Leaving the Omo about 5° 30′ N. lat. he made for the Nile and Fort Berkeley. In this part of his journey he reports a vast plain between the Nile and Lake Rudolf divide and the Latuka territory, extending to the Pibor and the Sobat. Its altitude is only 1500 feet; in the rainy season it is a swamp, and in the dry season a hard-baked and cracked desert. After leaving the Daua Dr. Donaldson Smith has traversed a good deal of new ground. His observations and collections will be of the greatest importance. He reports, unfortunately, that the Abyssinians have raided the Boran territory, and have practically seized possession of it, notwithstanding its inclusion in the British sphere. Dr. Donaldson Smith came down the Nile with Major Peake, who arrived at Fort Berkeley on the 5th of May, after cutting through the last of the *sudd* in the Bahr el Jebel. Both arrived at Omdurman on the 22nd of May.

AMERICA.

A New Railway in Brazil.—A line of railway is projected to connect São Paulo and Bahia. It starts from the Conquista Station on the Mogyana Railway, and will pass through Araxá, Sacramento, and Bagagem, and cross the Serra dos Piloes to Paracatú, a centre of pastoral industries. The line will terminate at the port of Burity, on the Paracatú affluent of the São Francisco river. The length of the line thus projected is 500 kil., for which a guarantee is required from the different States interested. The line would, it is stated, serve a very fertile and productive zone.

The S. Paulo and Rio Grande Railway.—This line will start from Itararé, a station on the Sorocabana Railway on the frontier of Paraná, will traverse the States of Paraná and join the terminus of the Chemin de Fer Sud-Ouest Brásilien on the frontier of Paraná and Rio Grande do Sul, a total distance of over 900 kil., exclusive of a branch to the Upper Paraná, with a length of 900 kil. more. The first section has recently been inaugurated; it extends from Pirahy to Rebouças, a distance of 229 kil., passing through Castro and Ponta Grossa, a station on the Curityba railway already open to traffic. The line is of metre gauge.

NEW BOOKS.

Guide de l'Immigrant à Madagascar. Publié par la Colonie avec le concours du Comité de Madagascar. Paris: Armand Colin et Cie., 1899. 3 vols. and Atlas. Pp. 409, 587, and 439 respectively. *Price* 40 *frcs.*

Many years ago a small book was published with the fascinating title of *Enquire within upon Everything.* The work which is now before us bears the modest title of *Guide de l'Immigrant à Madagascar*, but might very fairly claim the title of "Enquire within about everything in connection with Madagascar and a good many other things as well." This publication of the Government of Madagascar is indeed an exhaustive, and it has to be confessed an exhausting, account of what is known, conjectured, and anticipated in connection with the

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island. There are three portly volumes, and an atlas containing forty-one maps, plans, etc., and we may confess at once that it is hopeless to attempt to give even a faint indication of the varied contents. England is a country which in its day has done a good deal to further emigration and to assist emigrants, but so far as we know, none of our colonies nor our Colonial Office has ever published a work on the same lines or in the same detail as this. An early chapter deals with the geography of the island, and is subdivided into half a dozen sections dealing with orography, geology, hydrography, forestry, climatology, and ethnography; and as an example of what is provided for the information of the emigrant we may remark, that under the head of the Sakalaves we have set forth what is known of their subdivisions, habitations, villages, utensils, food, customs, religions, superstitions, language, differences of pronunciation, vocabulary and grammar, hierarchy, genealogical lists of the kings of Bouéni, lists of the kings of Bouéni still living and of the realms over which they rule, unclassed or bastard families, death of the kings, funerals, ceremonies, games, songs, dances, family life, etc. The remaining chapters of the work deal with productions, industries, commerce, cultivation, colonisation, roads and means of communication, hygiene, official documents and legislation, under which last head we have in full the Code of Madagascar as it stood in 1881, and every law or decree of the French Government affecting the island since the occupation.

The atlas is very complete. We have physical, geological, ethnological, and mineralogical maps of the island—others showing roads, railways, communications, etc., and numerous plans of the principal towns in addition to maps of the Suez Canal, the Bay of Aden, and other places passed on the voyage. The whole work is most creditable to those who prepared it and to the publishers, but we fear that its very elaborateness and detail will deter rather than encourage the emigrant.

The Yangtze Valley and Beyond. By Mrs. J. F. Bishop, F.R.G.S. London: John Murray, 1899. Pp. xii + 557. *Price* 21*s. net.*

This is an extremely interesting volume and well sustains Mrs. Bishop's reputation, both as an intrepid traveller and a chronicler of events by the way. We learn from the preface that the authoress undertook her journey up the Yangtze valley with no intention of making a book; but with the instinct of the "born" traveller she could not but keep a faithful record of her daily experiences. This, along with letters and photographs, has enabled Mrs. Bishop to meet the wishes of her friends by giving to the world one of the most readable of the recently published books on China.

One great merit of the book is that the illustrations are no mere embellishment, but have an intimate connection with the text. There are 116 in all, the great majority being reproduced from her own photographs. An inspection of these and a cursory glance at the neighbouring page will suffice to give an intelligent reader a useful variety of Chinese and "Mantze" lore. All possible subjects are represented: mountain scenery, river scenery, street scenes, temples, castles, tombs, bridges, gods, and human beings of low and high estate.

The route followed by Mrs. Bishop is clearly shown in a serviceable map, not overcrowded with names. The journey from Shanghai to Hankow and on to Ichang was made in comfort by steamers. The further reach by boat to Wan Hsien was the beginning of troubles and dangers. The river becomes so rapid at places that the boat has to be pulled up by ropes; and a graphic description is given of the shooting of the rapids by boats on their down journey. The pilots who take charge of the boats during this dangerous passage form an important

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and highly esteemed class; and that the danger is considerable is proved by the fact that the traveller removes from the boat his "treasures" as well as himself and re-embarks below the rapids. As usual in China away from the main routes, considerable delay was experienced in the start from Ichang and from other centres. At Wan Hsien Mrs. Bishop left the great river and pursued a generally westerly route to the north of the Chengtu Plain, a region which does not seem to have been described by any previous visitors.

The town of Somo was the limit of their journey; and the return to Chengtu was made by the same route by which they had come. From Chengtu Mrs. Bishop returned to civilisation by water, the first thousand miles being accomplished in a small flat-bottomed boat.

The last few chapters deal with the perennial problems of opium, Christian Missions, and the future of China, and give the final views of one who is unquestionably the greatest lady traveller in the Orient.

Pictures of Travel, Sport, and Adventure. By GEORGE LACY ("The Old Pioneer"). London: C. Arthur Pearson, Limited, 1899. *Price* 15*s*. Pp. 420.

Owing to the war in South Africa, as well as to its intrinsic merits, this book deserves attention as a faithful narrative by an impartial spectator of South Africa and the Boers. There are Australian and New Zealand "pictures" in it as well, but the South African ones are of present interest. Mr. Lacy tells how in 1867 he went into the "smouse" or travelling-trader line for eight months, and wandered throughout the whole of the northern half of the Orange Free State and the southern end of the Transvaal. He and his companions had about £2000 invested in the business, which was to sell all manner of goods to the Boers, and to enjoy the sport the country afforded. His "picture" of a Boer interior, not far from Majuba Hill, is decidedly clever, including "the head Boer, tall, gawky, and loose-jointed, with tangled, reddish hair, flabby, unwholesome face, plentifully ornamented with dirt, and short, thin, scrubby beard, stained with tobacco juice—his hands large, long, and bony, and on their backs could still be seen some of the dried blood of the last wildebeeste he had killed, probably two or three days before"; whilst his "*vrouw* was fat and frowsy, and clad in a dirty print gown—her stockingless legs were visible to the calf, and were only a little less dirty than the Boer's, and she wore the twin pair of veldschoens to his." "The eldest son was a copy of his father, but wore a jackal's tail and an ostrich feather in his hat, and smoked a pipe of green soapstone of the old German shape." "The *meisjes* were the only members of the family one could approach without disgust, as they were less dirty, and their features, when not buried in the poke, were often pleasing." In the course of inspecting goods, however, the *vrouws* and *meisjes* exhibited decidedly shaky notions of *meum et tuum*; "in fact," says the author, "whatever they may be now, the whole race of Boers, men and women, were in those days a pack of thieves."

Mr. Lacy had also a good many adventures in Natal, on one occasion riding from the Tugela into the Transvaal, and covering more than 2000 miles in three months. He remarks, regarding the rains, "I have known this same Tugela rise twenty-five feet in two hours"; whilst on one occasion "every bridge in Natal was swept away on the same day." The Tugela Falls are the most remarkable in Natal, being not less than 2500 feet, and forming a long succession of falls and cascades, visible from Colenso, fifty or sixty miles distant.

A chapter on South African "Traps and Horses" closes an entertaining and

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instructive volume, which is illustrated by numerous photographs and sporting sketches.

The Chronology of India from the Earliest Times to the Beginning of the Sixteenth Century. By C. MABEL DUFF (Mrs. W. R. RICKMERS). Westminster: Archibald Constable and Co., 1899. *Price* 15*s. net.*

This is a learned and trustworthy volume, which supplies the same place in research and literature regarding India as Fynes Clinton's well-known epitome does in relation to the chronologies of Greece and Rome. In some four hundred pages octavo, including a full index, we have a clearly printed table of events in chronological order, with marginal dates representing the year B.C. or A.D. Approximate dates—of which there must be many in so non-historical a literature as that of India—are printed in italics. For instance the date of Hippalus, who made the pregnant discovery of the south-west monsoon in the Indian Ocean, is given as A.D. 47, while the present writer has elsewhere preferred A.D. 50. The authorities are given in each case, so that the work is a stimulating book of reference. It is not difficult to trace the hand of one Fellow, Dr. James Burgess, C.I.E., whose "advice and help continually given" are warmly acknowledged. So the transliteration of the Chinese names has been supervised by Professor Douglas and Mr. Watters. The lamented scholar, Dr. Bühler, also gave invaluable assistance. While all this adds to the scholarly value of the book, it does not detract from the merit of the authoress, who qualified herself for the task by patient study in Germany and this country. Indeed, the volume so admirably supplies a literary gap that we close it with the suggestion that C. Mabel Duff should at once compile a continuation down to the present day, or the close of the century. The only work of that kind we know is a little anonymous cram-book published by Messrs. Blackwood, which we value only for the chronological lists of the Regulations and Acts of the East India Company, not easily to be found elsewhere. A large part of this volume consists of dynastic lists, of value to every Orientalist. The table starts from B.C. 3102, Friday, February 18th, the beginning of the Kaliyuga or Hindu astronomical era, or the 588,466th day of the Julian Period. That is not in italics, because it is astronomically verified. It is pleasant to be able to congratulate a granddaughter of Dr. Alexander Duff on so good a piece of Oriental workmanship.

Portuguese Nyassaland. An Account of the Discovery, Native Population, Agriculture and Mineral Resources and present Administration of the Nyassa Company, with a review of the Portuguese rule on the East Coast of Africa. By W. BASIL WORSFOLD. Pp. 258. 2 Appendices, Index, 24 Illustrations, 2 Maps in cover. London: Sampson Low, Marston and Co., 1899.

This exceedingly well-produced book is an account by Mr. Worsfold of the region for which a charter has been obtained by a Portuguese Company in an area lying between Lake Nyassa and the Indian Ocean. It comprises the whole of the former district of Cabo Delgado (a portion of the province of Mozambique), together with the islands lying off the coast-line. It is separated on the north from German East Africa by the course of the river Rovuma and the International Boundary of December 1886. Its western boundary consists of the eastern shore of Lake Nyassa and the International Boundary of June 1891, which separates Portuguese from British Nyassaland, and it is divided by the entire course of the Lurio river, from its source by Lake Chirua to its mouth,

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from the district of Mozambique. The area, which is roughly rectangular, embraces some 100,000 square miles. The charter was given in 1893.

This region of eastern Africa possesses advantages. It contains a gold, as well as a coal, area, and a district in which coffee thrives. The exports up to the present have been indiarubber, ivory, ebony, gum opal, and wax, as well as indigo, cloves, mother-of-pearl shells, and orchello.

The climate as a whole, owing to the high average elevation of the country, is superior to that of other districts situated in the same (or equivalent) degrees of latitude on either the west or east coast of Africa. The accounts of missionaries and travellers, and the reports of resident officials and engineers of the Nyassa Company, bear unanimous testimony to its general healthiness, and to the special suitability of the interior highlands for European colonisation.

The work is prefaced by three interesting chapters—one dealing with ancient Africa, another with the Portuguese in Africa, and then another on the present condition and prospects of Portuguese East Africa. In dealing with this last question, he says that the estimated area of Portuguese East Africa is 271,600 square miles; its revenue for 1894-95 was about £296,857, with an expenditure of £345,587. Now the trade of the colony would seem to be about £1,700,000, but of this £1,000,000 consists only of imports forwarded to the Transvaal and Rhodesia, through the respective ports of Lorenzo Marquez and Beira.

A White Woman in Central Africa. By HELEN CADDICK. London: T. Fisher Unwin, 1900. Pp. 242. *Price* 6*s.*

The authoress of this interesting book travelled in 1898 from the mouth of the Zambesi to Lake Tanganyika, and in her Preface says she should like English people "to know how kind and attentive the natives, who are spoken of in England as 'savages,' can be to a lady travelling absolutely alone with them." She ascended the Zambesi in a paddle-steamer, and describes the crocodiles, hippopotami, and brightly-plumaged birds she observed.

Historical Geography of the Holy Land. By S. R. MACPHAIL, M.A. With 42 Illustrations, Views, and Sketches. Edinburgh: T. and T. Clark, 1899. Pp. 188. *Price* 6*d.*

Considering that the title "Historical Geography of the Holy Land" has already been adopted by Prof. Geo. Adam Smith for his standard work on the subject, we think it would have been better taste on the part of Mr. Macphail to have respected the title of such a well-known book. A title such as "Historical Notes on the Geography of the Holy Land" would have been more applicable to Mr. Macphail's little book. For, good as it is, it cannot be compared with Prof. Smith's work, and it is surely desirable to avoid confusion through repetition of titles.

The Madeira Islands. By ANTHONY J. DREXEL BIDDLE. London: Hurst and Blackett, Ltd., 1900. Vol. i. pp. 324. Vol. ii. pp. 207. *Price* 20*s. net.*

It is difficult within three and a-half days' run from Southampton to obtain a more entire change of scene than is offered by Madeira, and to all who contemplate the trip we recommend this work. Mr. Biddle's labours have covered the whole field of Madeiran interests, past and present; and the results are presented in clear and attractive form, so that he who runs may read. In Vol. i. are the more literary and descriptive portions, while Vol. ii. deals with scientific and technical

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subjects, such as the wine industry, climate, flora, and fauna. Though belonging to Portugal, the chief interests in the island are in British hands, and English money is more common than the Portuguese reis. It is this fact which explains the curious termination of a riot in 1889, when a mob demonstrating against this country was routed by a force of boatmen, bearers, etc., whose income was dependent upon the presence of the hated foreigner. A feature of the book is the excellence of the photographs, especially in Vol. II., and the completeness of the index and cross references.

Cassell's Gazetteer of Great Britain and Ireland. A Complete Topographical Dictionary of the United Kingdom. With numerous Illustrations and sixty Maps. Vols. v. and vi. London : Cassell and Co., Ltd.

These volumes complete this excellent gazetteer, the publishers of which are to be congratulated on the issue of a work which has been so much needed. A very useful and distinguishing feature of the book is the list at the foot of each page, which shows at a glance the population and mileage statistics of the places.

Modern Spain, 1788-1898. By MARTIN A. S. HUME. London : T. Fisher Unwin, 1899. Pp. 374. *Price* 5*s*. ("The Story of the Nations Series.")

It would be impossible to read a more melancholy account than this of a country so torn by internal dissensions as to make settled government impossible. Mr. Hume is inclined to blame the unprincipled kings and inept ministers of Spain rather than the Spaniards themselves; but the licence, mutability, and ferocity displayed by the latter make them at least the guilty partners of their governors. Nor did the proverbial bigotry of Spaniards prevent their butchering priests and friars whenever they stood in their way. At the same time, the history of modern Spain is that of a fierce and ceaseless battle between the old school of Absolutism and the new school of Liberalism, resulting, as usual, in the triumph of the latter. Students of politics will find much to interest them in this volume, whose author points out that, like those of other countries, the Liberals of Spain turned to Britain for their inspiration, whilst the Absolutists looked to France.

Mr. Hume was specially qualified to write this book from his having himself witnessed most of the stirring scenes which occurred from the Revolution of 1868 to the death of Alfonso XII. in 1885. He does every justice to Godoy by citing his *Memoirs*, and to the equally unprincipled Fernando by quoting his *Diary*. Fernando's fourth wife, however, Cristina, does not appear to have been his "niece," as stated on page 270, but the sister of his sister-in-law, Carlota.

A good map of the Peninsula and portraits of the leading political characters complete a volume of much interest and value.

Neu-Guinea. Von Dr. MAXIMILIAN KRIEGER. Mit Beiträgen von Professor Dr. A. FREIHERRN VON DANCKELMANN, Professor Dr. F. VON LUSCHAN, KUSTOS PAUL MATSHIE, und Professor Dr. OTTO WARBURG. Mit Unterstützung der Kolonial-Abteilung des Auswärtigen Amtes, der Neu-Guinea-Kompagnie und der Deutschen Kolonial-Gesellschaft. Berlin : Alfred Schall. Preis : brosch.—mk. 11.50, geb. mk. 13.50.

This volume is published in the *Bibliothek der Landerkunde*. Its bulk is occupied by a very careful and thorough essay in practical anthropology; the

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people of New Guinea are described from many different points of view, neither physical nor psychological conditions being neglected. The evidence for the description has been collected in a scientific manner by competent observers. Dr. Krieger expresses a hope in his preface that his book may tend to the advancement of colonial work in the island; and this it cannot fail to do—light thrown on a savage people, especially on their beliefs and prejudices, is always a very real help in their proper government. Nor does the author neglect the physical geography of the island, its natural products, trade, and capabilities. Having due regard to the variety of conditions which must prevail in different parts of so large a country, he has wisely decided to describe Kaiser Wilhelmsland, British New Guinea, and Dutch New Guinea severally. He discusses each of these districts under six headings—(1) Coast and Area; (2) Population; (3) Social and Religious Conditions, Psychology, Speech, Amusements, etc.; (4) Natural Products; (5) Commerce and Traffic; and (6) Colonisation. The section on the people he further divides into five sub-sections, thus ensuring the easy discovery of any particular information desired. Of the five independent essays, all of which are of a technical nature, the ethnographical and botanical, by Professor von Luschan and Professor Warburg respectively, are the most interesting. That on zoology, by Herr Matschie, neglects all but the higher vertebrates; the fish are dismissed in a single paragraph, and the invertebrates in a short page. The volume is illustrated by a sufficiency of maps, photographs, and drawings; and its value is increased by references to the works of former writers upon New Guinea. The maps are excellent, and the photographs reach a fair average of clearness, but some of the zoological figures lack definition: those illustrating the botany and ethnology could not be improved upon.

Journals and Papers of Chauncy Maples, D.D., F.R.G.S., late Bishop of Likoma, Lake Nyasa, Africa. Edited by ELLEN MAPLES. Longmans, Green, and Co., 1899. Pp. 278. *Price* 6*s.* 6*d.*

How worthy to be named with Livingstone and Mackenzie, Mackay and Bain Bishop Chauncy Maples is we showed in a review of his *Life* in these pages. This collection of his published writings on Central Africa completes the service done by his sister to the civilisation and Christianisation of the Bantu peoples. So long ago as 1888 our *Magazine* published his model paper on "Likoma," the little island in Lake Nyasa from which the Missionary bishopric is named. That article is here reproduced, with several others of almost equal merit, on the countries in Portuguese and German East Africa in which he made his missionary tours—such as Meto, Newala, and the land of the fierce Gwangwara. Better even than these are the Zoological and other Natural History descriptions, which have been revised by experts. A good map and portrait complete this valuable book.

Twelve Pioneer Missionaries. By GEORGE SMITH, C.I.E., LL.D. With Portraits. London, Edinburgh, and New York: Thomas Nelson and Sons, 1900. Pp. 304. *Price* 7*s.* 6*d.*

The occasion for the issue of this volume is the recent celebration, by more than one of the Great British Protestant Missionary Societies, of the completion of the first century of their existence. The list of twelve missionaries selected for commemoration by Dr. Smith comprises by no means all the pioneers of Christian missionary enterprise in modern times in the various non-Christian countries of the world. Some notable names are absent; and several non-Christian regions where

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the propagation of the Christian religion is being carried on are unmentioned, or barely referred to. Seven of the selected pioneers laboured in India (two, indeed, being natives of India), three (one of them in the thirteenth century) in Africa, one in Arabia, and one in the islands of the South Pacific. But the author doubtless had reason for his choice of men and mission fields; and in most instances he has conjoined with the biography some account, not only of the circumstances that led to or attended the pioneer's going forth, but also of subsequent missionary efforts in the same region.

Little notice is taken in the book of missionary journeys of exploration. In this respect it scarcely falls within the purview of a geographical reviewer. There is, however, one aspect of its subject with which geography, as a secular science and as connected with social and political history, is concerned. Few will doubt that if the Christian religion were largely to supplant, in non-Christian countries, the existing religious systems and customs, and were to become part and parcel of the national life of the populations, their mental and moral character and social development would be greatly changed. From this political and social results might—we may perhaps say would certainly—ensue, which geography, in the wide sense of the term, would have to take cognisance of. It is still a day of small things with modern Christian missions. In India, for example, not one-half per cent. of the native population is Christian, and in almost every part of the country one may go a day's journey without encountering or hearing of a native Christian. Yet the parables of the mustard-seed and the leaven are still read and heard among us. If they foreshadow the event, the historians and geographers of our present non-Christian countries will have strange things to record in centuries to come. To them the missionary story of the nineteenth century will be of surpassing interest. It ought not to be devoid of interest now, even if the interest be only speculative.

Whitaker's Naval and Military Directory and Indian Army List, 1900. London: J. Whitaker and Sons. Pp. 918. *Price* 5*s*.

A handy reference book, containing lists of active and retired officers of both services, a colonial army list, etc. At p. 581 is a casualty list for South Africa, 1899.

Macdonald's Scottish Directory and Gazetteer, 1899-1900. Edinburgh. Pp. 1117. Edinburgh: Wm. Macdonald and Co., Ltd. *Price, for Great Britain*, 21*s*.

In the first part of this volume some 400 pages are given to the chief towns, then follow the "counties," "banks," and a "mercantile Guide"; the last 44 pages are taken up by a gazetteer. The map and plans are somewhat sketchy.

Vingt-deux mois de campagne autour du monde. Journal d'un aspirant de marine. By Le Comte Henry de Menthon. Paris: E. Plon, 1900. Pp. 312 and Map.

This is the journal of a young sailor, written ten years ago, describing his voyage round the world. It shows a considerable power of observation and of literary feeling.

The Story of the Nations—Modern Italy, 1748-1898. By Pietro Orsi. London: T. Fisher Unwin, 1900. Pp. 404. *Price* 5*s*.

The author, who is Professor of History at Venice, here gives a vigorous account of the development of Modern Italy. It is a purely political work, dealing chiefly with the stirring history of Italian unification. The book is

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illustrated by many portraits and scenes of buildings, and has been excellently translated into English.

Das Meer als Quelle der Völkergrösse; eine politisch-geographische Studie. By FRIEDRICH RATZEL. Leipzig: R. Oldenbourg, 1900. Pp. 85. *M.* 1.20.

This little book, by the Professor of Geography at Leipzig University, appears at a moment when the question of sea power is rightly receiving much attention in Germany; and is successful in representing, clearly and forcibly, the leading ways in which coastal frontiers modify the character and the destiny of peoples. It should be read in Britain as well as in Germany.

Corfou et les Corfiotes. By Dr. ARTHUR DE CLAPARÈDE. Geneva: H. Kündig, 1900. Pp. 176.

This interesting little work, by the President of the Geographical Society of Geneva, gives a concise account of the conformation of the island, its climate and agricultural conditions, its history, population, and customs. Other chapters deal with special places and buildings on the island. The author's identification of Homeric places should be read by lovers of Nausicaa. "*C'est l'Odyssée à la main qu'il faut se promener à Corfou.*"

Einundwanzig Jahre in Indien—I. Theil: Borneo. By Dr. H. BREITENSTEIN. Leipzig: Th. Grieben, 1899. Pp. 254. *M.* 5.50.

Dr. Breitenstein's experiences are valuable from many points of view; as a medical man, naturalist, and ethnologist he has a great deal that is new to say with regard to Borneo, its climate and diseases, the conditions of life there, and the natural products of the country. He concludes a most interesting volume by a history of South-East Borneo.

Assyrien und Babylonien nach den neuesten Entdeckungen. By Dr. FRANZ KAULEN. Fifth edition. Freiburg, i. B., 1899. Pp. 316. *M.* 5.

This latest edition of Dr. Kaulen's celebrated work has been brought into line with the most recent results of Assyriological research and criticism. It is vigorously written and well illustrated, and forms an admirable introduction to the study of various aspects of the ancient civilisation.

The Life of Alexander Duff, D.D., LL.D. By GEORGE SMITH, C.I.E., LL.D. Fourth English edition. Revised and abridged. London: Hodder and Stoughton, 1900. Pp. xv + 383. *Price 6s.*

This new popular edition of Dr. Smith's memoir of the famous Indian missionary has been somewhat abridged by the author, and brought down to date. The book, which is too well known to require comment, has for some time been out of print; and the fourth edition will be welcomed by all who are interested in educational and other missionary work.

Historical Atlas of Modern Europe. Edited by REGINALD LANE POOLE, M.A., Ph.D. Oxford: Clarendon Press.

Twenty-five parts of this Atlas have now reached us. We intend to review this work as a whole on its completion. It is sufficient at present to say in general terms that the work was called for and is being ably fulfilled.

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THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

BOTANICAL SURVEY OF SCOTLAND.

II.

NORTH PERTHSHIRE DISTRICT.

By ROBERT SMITH, B.Sc., University College, Dundee.

THE objects aimed at in the present survey, and the methods employed, have been explained in my former paper dealing with the Lowland district of Midlothian (8).[1] The North Perthshire map, which is now offered, will illustrate the application of these methods to a Highland district, where the features of the vegetation differ in many ways from those of the more temperate region.

The district now represented is one of much general interest, and includes some of the finest mountain scenery of Scotland. It is part of the basin of the Tay, and is traversed by that river and its tributaries, the Lyon, the Tummel, and the Bran. The altitude ranges from 100 feet (30 metres) in Strathmore to 4000 feet (1216 metres) on the cairn of Ben Lawers. Only a small part in the south-east corner is lowland in character, and is sharply marked off from the mountain region by the great boundary fault which runs diagonally from south-west to north-east, between the Old Red Sandstone of Strathmore and the more ancient metamorphic rocks of the Highlands. By far the greater portion of the area is moorland and pasture, intersected by narrow fertile valleys.

As was the case with the Edinburgh district, the main botanical subdivisions of this district are determined by altitude. Three main regions may be at once recognised :—

[1] These numbers refer to the bibliographical list at the end of the paper.

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(1) Temperate Region, including the sub-regions of cultivation, and of mixed deciduous trees.
(2) Sub-Alpine Region, including the sub-regions of coniferous and birch-trees, and of hill pasture and moorland.
(3) Alpine Region.

Each of these regions is inhabited by its own particular plant associations, which require for their development the particular conditions of environment existing within the region. In the following paper these regions are considered in turn, and the relationship between their vegetation and their life-conditions, so far as yet determined, is indicated.

Region of Cultivation.

(*Region of Temperate Europe.*)

The cultivated area shown on the present map belongs almost entirely to the upper sub-region of cultivation with oats as the chief cereal crop, for the few wheat-fields of the district are confined to a small portion of Strathmore in the south-east corner of the area. The line which indicates the upper limit of present or recent wheat cultivation will be seen to run about 500 feet (152 metres), only here and there rising to 600 feet (182 metres). It is thus approximately the same as determined for Midlothian, although here the wheat-fields near the upper limits are fewer and more scattered. Oats are grown successfully up to the limits of cultivation. On the steep slopes facing Strathmore the limiting line is about 800 feet (243 metres), but in the Highland valleys altitudes from 1000 to 1250 feet (304 to 380 metres) are frequently reached, whilst traces of former cultivation can be noted in some parts as high as 1500 feet (456 metres), as, for example, near Craig-choinnich Lodge, on Beinn a' Ghlo. 1250 feet can, however, be regarded as the limiting altitude in general for cereal cultivation in this district. As a rule, the elevations attained on the sides of the valleys facing the south are greater than on those facing the north, as can be well seen in the vicinity of Loch Tay, Blair Atholl, and Pitlochry.

The relationship between the regions of vegetation and the temperature and rainfall cannot be so clearly indicated here as in the case of the Edinburgh district, because of the scarcity of meteorological data. Such statistics, however, as we do possess show that the mean summer temperature over the wheat area is not below 56° F. (13·3° C.), the minimum required under ordinary conditions for the ripening of the wheat (1). In fact, the temperature for all the land under 500 feet (152 metres) in this district, as shown in the map accompanying Dr. Buchan's recent paper (3), is somewhat above the required 56° F., Taymouth, for example, at an altitude of 372 feet (113 metres), having a mean July temperature of 57·3° F. (14·1° C.). The mean summer temperature up to 1250 feet (380 metres) is shown to be over 54° F. (12·2° C.). Above that altitude it may in general be expected to be below that amount, although at Dalnaspidal [1414 feet (430 metres)],

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just beyond the limits of ordinary cultivation, it is as much as 54·4° F. (12·4° C.).

In Midlothian the rainfall of the wheat region hardly exceeds 30 inches per annum. In this district it seems to be greater, for Stanley (lying just outside the present map), the only recording station in this part of the wheat region given in Dr. Buchan's paper (2), has an annual rainfall of 31·49 inches. Thus, although the summer temperature of the district is favourable for grain production, the greater moisture, especially in the Highland valleys, on the other hand, tends to render this production unprofitable. The rainfall increases greatly towards the west, even exceeding 60 inches in the vicinity of Killin. The other records of mean annual rainfall for this region given in Dr. Buchan's paper (2) are:—Inverbraan, 39·81 inches; Pitlochry, 37·01 inches; Bonskeid, 36·87 inches; Dalnaspidal, 59·83 inches.

Where the rainfall is as great as this, cereal cultivation is very much reduced, and is replaced by pasturage. The diminution in the cultivated area towards the west is very clearly observable on the map; a similar diminution towards the west is also indicated, although less markedly, on the Midlothian map.

The flora of the cultivated area is largely made up of introduced species, many of which are more or less casual in their occurrence. A distinct diminution in the number of these species is observable as the altitude is increased. The data which have been collected in the *Flora of Perthshire* by the late Dr. Buchanan White (9) permit us to estimate the number of species occurring in each sub-region of cultivation. Thus out of some 280 species which may be regarded as inhabitants of cultivated ground, only about 100 are found in the upper parts of the region above the limits of wheat cultivation, or above 500 feet (152 metres) in the Highland valleys.

Tree Regions.

The tree vegetation in North Perthshire is of more varied character, and of greater interest than in the lowland district of Midlothian. Yet even here, as can be seen from the map, it occupies relatively a very small portion of the total area, and even of the possible area for tree cultivation, for it is mostly confined to the valleys. Arboriculture is, on the whole, subservient to pasturage and game-preserving.

The different types of woodland represented in the district can all be well observed from the bridge over the river Tay at Dunkeld. If the rich tree vegetation surrounding that point of view be carefully examined, at least five distinct types can be distinguished:—

(1) On the banks of the river and in the park-lands at low elevation the trees are southern in character. Beech, oak, sycamore, elm, ash, Spanish chestnut, horse chestnut, lime, walnut, etc., occur here mixed, as they have been planted for ornamental effect. Some of the trees, especially the beech and oak, are magnificent examples of their kind.

(2) On the lower slopes of most of the hills the trees are mainly oaks

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in the form of coppice, being cut down periodically and allowed to sprout again from the stumps.

(3) Above the oak belt the slopes of the hills are almost wholly planted with larch-trees. These are well seen on Newtyle Hill, and on both sides of the valley above Dunkeld.

(4) Mixed to a certain degree with the larches, especially on the rocky front of Craigie Barns, are clumps of Scots pine, standing out sharply from their deciduous neighbours.

(5) One other tree besides the larch and pine is well marked on the higher slopes; this is the birch, which covers much of Birnam hill, and occurs on all the other hills in patches mixed with the other species.

View from Dunkeld Bridge, looking down the river.

Spruce, silver fir, alder, etc., also form small clumps, distinguishable by a keen observer, but none of them are in any way so conspicuous as the five types just mentioned, which are the only ones represented on the present map. The grouping of these five species into distinct societies depends upon the fact that each has its own particular conditions of life, and each grows where it finds these present. Thus the mixed deciduous trees find the most favourable temperature for their development on the low grounds; the oaks flourish well on the lower slopes and on the old river-terraces; while the hardier larches, pines, and birches clothe the heights.

A further subdivision is employed here than was possible in Midlothian, where only the two main divisions, (1) mixed deciduous woods,

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(2) coniferous woods, could be adequately represented. Here it is possible to show the following:—

(*a*) Temperate woods:—

1. Mixed deciduous woods, mainly beech and oak.
2. Oak woods.

(*b*) Sub-Alpine woods:—

3. Larch woods.
4. Pine woods.
5. Birch woods.

Old Oak Tree, Birnam.

Region of Deciduous Trees.

(*Region of Temperate Europe.*)

In primitive Scotland the oak (*Quercus Robur*, L.) seems to have been the dominant element of this region, and in the district we are considering it still plays an important part—much more so than in Midlothian, where it is largely superseded by the introduced beech (*Fagus sylvatica*, L.). At low elevations, in plantations, park-lands, and dens, the mixture of the two species is the rule, but where the two trees are planted close together the dense shade cast by the beech prevents the growth of the native species.

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The oak, however, reaches a higher altitude than its rival. On the map it will be seen that the mixed deciduous woods cease about 700 feet (213 metres) [although small patches of isolated beech-trees may be found over 900 feet (274 metres)], whilst oak woods, such as those near Kenmore, reach 1000 feet (304 metres), and isolated trees occur even higher.

The oak, especially in the form of coppice, is one of the most marked features of the Highland border. It forms a narrow belt of tree vegetation, quite clearly marked, although frequently broken by cultivation, on both sides of the Tay valley from Dunkeld to Loch Tay. It likewise extends up Strath Tummel to Loch Rannoch, but is by no means

Scots Pines. On the Bran, above Amulree.

so distinct in this valley, as it is largely mixed with or replaced by birch. In Strath Garry it constitutes part of the vegetation of the Pass of Killiecrankie, but farther north it diminishes in importance, practically ceasing about Blair Atholl.

We can readily conceive that before human influence restricted the range of the different species a keen competition existed between the oak and Scots pine for possession of the area. The general climatic conditions of the land below 1000 feet are suitable for either species. If the two species start equally well, and in close proximity, the oak tends to crush out the pine, both by reason of its deeper shade and of its stronger branches. Where a clearing has been made, however, and the sun has dried up the soil, or where water has accumulated from ill-

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drainage and moss has sprung up and formed peat, or where animals graze on the seedlings, the pines tend to spring up more readily, and may for a time restrain the spreading of the oak. The remains of both species are found in the peat bogs, and probably each alternately dominated over the land. We have in fact in this district a meeting of two great regions of vegetation—the temperate and the sub-Alpine regions —which are similarly indicated in every mountainous country of Europe by deciduous and by coniferous trees respectively. An analogous state of affairs, for example, has been described by Professor Flahault in the valley of Barcelonnette in the Maritime Alps (4). There the oak region is well developed, extending to altitudes between 900 to 1000 metres (2960 to 3289 feet), but wherever man has cut down the trees, and left an open space, especially facing the south, which has been warmed and dried, the Scots pine has entered as an invading species, and tends to prevent the regeneration of the oak wood.

The subordinate vegetation of the mixed deciduous woods is in general character similar to that of Midlothian. The oak woods, however, contain an association of plants which differs in composition from that of more mixed woods with beech as one of the chief species. These differences from the beech association are directly connected with the greater light which penetrates through the oak foliage. More trees are found mixed with the oak, and an undergrowth of shrubs is characteristic. The chief species of this association are summarised in the following classified list:—[1]

Trees mixed with the dominant species:—

Ilex Aquifolium, L. (Holly).
Prunus spinosa, L. (Sloe).
Prunus Avium, L. (Gean).
Pyrus Aucuparia, Ehrh. (Rowan).
Cratægus Oxyacantha, L. (Hawthorn).
Fraxinus excelsior, L. (Ash).
Ulmus montana, Stokes (Wych Elm).
Betula alba, L. (Birch).
Alnus glutinosa, Medic. (Alder).
Corylus Avellana, L. (Hazel).
Fagus sylvatica, L. (Beech). [Isolated examples.]
Populus tremula, L. (Aspen).
Salix, spp.

Chief grasses forming the carpet under the trees:—

Anthoxanthum odoratum, L.
Holcus mollis, L.
Holcus lanatus, L.
Agrostis vulgaris, With.
Festuca ovina, L.

Other conspicuous social species:—

Rubus idæus, L.
R. fruticosus, L.
Vaccinium Myrtillus, L.
Pteris aquilina, L.

General list of frequent associates:—

Anemone nemorosa, L.
Ranunculus acris, L.
Viola Riviniana, Reich.
Polygala vulgaris, L.

[1] The nomenclature of these lists is that of the *London Catalogue of British Plants*, 9th edition, 1895.

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Cerastium triviale, Link.
Arenaria trinervis, L.
Oxalis Acetosella, L.
Trifolium repens, L.
Vicia Cracca, L.
Lathyrus montanus, Bernh.
Fragaria vesca, L.
Potentilla Fragariastrum, Ehrh.
P. silvestris, Neck.
Circæa lutetiana, L.
Galium saxatile, L.
Valeriana officinalis, L.
Scabiosa succisa, L.
Calluna Erica, DC. (occasionally.)
Primula acaulis, L.
Scrophularia nodosa, L.
Veronica officinalis, L.
V. Chamædrys, L.
Melampyrum pratense, L.
Stachys sylvatica, L.
Teucrium Scorodonia, L.
Ajuga reptans, L.
Myrica Gale, L. (in wet spots).
Athyrium Filix-fœmina, Roth.
Lastrœa Filix-mas, Presl.

In this district, as in Midlothian, the flora of the deciduous woods includes a number of species which in all probability were formerly much more abundant, but which have, through disforesting and other causes, become restricted to a few isolated stations. The chief of these, as determined from White's *Flora of Perthshire* (9), are given in the following list :—

Vicia Orobus, DC.—Kinloch-Rannoch and Glen Tilt.
Lathyrus niger, Wimm.—Killiecrankie.
Campanula latifolia, L.—Aberfeldy, etc.
Veronica montana, L.—Dalguise and Castle Menzies.
Melampyrum sylvaticum, L.—In various localities.
Origanum vulgare, L.—Near Blair Atholl.
Stachys Betonica, Benth.—Rumbling Bridge, Strathbran.
Neottia Nidus-avis, Rich.—Rumbling Bridge, Craigie Barns, Moness, near Kinloch-Rannoch, Pass of Killiecrankie, and Lawers Den (July 1900, R. S.).
Epipactis palustris, Crantz.—Near Pitlochry and Blair Atholl.
Polygonatum verticillatum, All.—Near Pitlochry, Killiecrankie, and Blair Atholl.
Convallaria majalis, L.—Near Pitlochry, Killiecrankie, and Glen Tilt.
Gagea fascicularis, Salisb.—Near Inver, and Pitlochry.
Paris quadrifolia, L.—In a few stations.
Milium effusum, L.—Dunkeld, Moness, and Glen Tilt.
Calamagrostis epigeios, Roth.—Near Dunkeld.
Festuca sylvatica, Vill.—Strathbran, Inver, Acharn, and Allt Girnaig.
Bromus giganteus, L.—In a few stations.
Scolopendrium vulgare, Symons.—Acharn and Killin.
Equisetum hyemale, L.—Kenmore.

Region of Coniferous and Birch Trees.

(Region of Sub-Arctic or Sub-Alpine Europe.)

As already mentioned, three trees dominate in this region, the Scots pine (*Pinus sylvestris*, L.), the larch (*Larix europæa*, L.) and the birch (*Betula alba*, L.). The woods of the larger valleys are mostly made up

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of the first two species, in particular the larch, but in the more remote parts they are almost completely composed of birch. Small patches of alder, hazel, and willow occur, but nowhere cover any extent of ground.

The Scots pine is undoubtedly the native tree characteristic of this region, as it grows well in most parts, and remains of its earlier forest are found buried in many peat bogs. The Black Wood of Rannoch on the south shores of Loch Rannoch is believed to still represent a part of the primitive Caledonian forest, but elsewhere in the district the trees have been comparatively recently planted. The Black Wood is somewhat thin now and much mixed with birch, but it bears an aspect of antiquity, suggestive of its primitive character, such as is quite foreign to most of the other pine woods of the region.

Scots Pines and Larch. On Craigie Barns.

During the past century more larch has been grown than Scots pine, but the prevalence of larch canker, caused by the fungus *Dasyscypha* (*Peziza*) *Wilkommii*, Hartig, on the trees of the newer plantations has checked its introduction, and at present the native pine is tending to replace it. The planting of the larch woods of the Atholl district was one of the greatest steps made by scientific forestry in the country. It was largely the work of John, fourth Duke of Atholl, who, between 1774 and 1826, planted as many as fourteen million plants, covering 10,324 imperial acres. The larch was first introduced into Scotland in 1738, and two of the first trees still stand beside the cathedral at Dunkeld. For further particulars regarding the introduction of the larch the reader is referred to general works on the forestry of the country, and in particular to the work by Mr. Hunter on the woods of Perthshire (5).

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It is quite probable that most of the land up to 2000 feet (608 metres) could, after careful study of the conditions, be made to bear coniferous trees furnishing good timber. None of the woods at present reach that altitude, the highest just passing 1800 feet (547 metres), as, for example, Craig hill near Kenmore, or above Meggernie in Glen Lyon. Both species, however, grow better at somewhat lower elevations, and seem very similar with regard to their altitudinal requirements, the pine resisting perhaps somewhat better the extreme conditions at high altitudes. The altitudinal limit for isolated pine-trees given in White's *Flora* is 1900 feet (578 metres) in Atholl.

The pine-trees in many parts seed themselves quite readily, but the seedlings, although numerous and starting well, are usually eaten down by grazing sheep, rabbits, or deer, and thus the natural regeneration of

Seedling Pine on island. On Craigie Barns.

the woodland area is greatly hindered. In the accompanying illustration one of these seedling pines is shown, which has sprung up on a heather-covered island in a little mountain tarn on Craigie Barns, and has there managed to escape grazing animals. Seedlings which have been self-sown can also be seen springing up on some of the islands in the river Tay, where their isolated position has protected them.

The area under birch woods shown on the map is interesting, since it represents the part of the woodland which is quite natural and self-sown. This tree springs up easily and quickly on the clearings of pine or oak woods, on moorland and on pasture, so long as these are not too closely grazed. If allowed full scope it would cover much of the sub-Alpine region. It reaches a considerable altitude, small patches on

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the mountains south of Loch Rannoch touching 2000 feet (608 metres), whilst isolated examples—for example, on Beinn a' Ghlo above Glen Tilt—are found as high as 2300 feet (699 metres). The trees at these extreme altitudes are, however, usually small and stunted, compared with those found in the valleys.

The subordinate vegetation in the sub-Alpine woods is of a less marked character than that in the temperate woods, hardly differing,

Scots Pines. On the Tilt near Blair Atholl.

except in the proportion of the individuals present, from the adjoining moorland or hill pasture. This is owing to the comparatively slight shade cast by these woods. In the pine woods heather and its associates usually constitute the plant carpet, whilst in larch and birch woods the ground is more often covered by grasses and bracken, although this rule is by no means invariable.

The birch woods in the shelter of the river valleys may, however, have as rich a vegetation as the oak coppice, and indeed may be regarded as having replaced that association. Thus, for example, a list taken in the birch wood between Loch Tummel and the Falls of Tummel shows a

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flora almost identical with that already given as characteristic of the oak coppice.

Many of the woodland species cease about the same altitudes as the trees which shelter them. Thus all these rare species given above as peculiar to deciduous woods do not pass 1000 feet (304 metres), the upper limit of the oak woods. Those which are given in the following

Birches. Strath Bran.

list cease before 2000 feet (608 metres) are reached, the altitude which may be regarded as the maximum limit of tree vegetation.

Ranunculus auricomus, L.
R. Ficaria, L.
Stellaria nemorum, L.
S. umbrosa, Opiz.
S. Holostea, L.
**Arenaria trinervis*, L.
**Hypericum perforatum*, L.
**Geranium pratense*, L.
G. lucidum, L.
**Ilex Aquifolium*, L.
**Prunus Avium*, L.
**P. Padus*, L.
**Rubus fruticosus*, L.
Geum urbanum, L.
Fragaria vesca, L.
Potentilla Fragariastrum, Ehrh.
**Agrimonia Eupatoria*, L.
Epilobium montanum, L.
**Circæa lutetiana*, L.
**C. alpina*, L.
**Sanicula europæa*, L.
Conopodium denudatum, Koch.
Hedera Helix, L.
Lonicera Periclymenum, L.
Linnæa borealis, Gron.
Asperula odorata, L.

* Hardly passing 1000 feet

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Valeriana sambucifolia, Willd.
Pyrola media, Sn.
P. rotundifolia, L.
P. secunda, L.
Primula acaulis, L.
Scrophularia nodosa, L.
Digitalis purpurea, L.
Veronica officinalis, L.
**Nepeta Glechoma*, Benth.
**Stachys sylvatica*, L.
**Lamium album*, L.
Teucrium Scorodonia, L.
Ajuga reptans, L.
Ulmus montana, Stokes.
Alnus glutinosa, Medic.
Corylus Avellana, L.
Salix cinerea, L.
S. caprea, L.
Populus tremula, L.
Corallorhiza innata, R. Br.
**Listera ovata*, R. Br.
Orchis mascula, L.
**Allium ursinum*, L.
**Scilla festalis*, Salisb.
Luzula vernalis, DC.
**Carex remota*, L.
C. pallescens, L.
**C. lævigata*, Sm.
C. sylvatica, Huds.
Holcus mollis, L.
H. lanatus, L.
Arrhenatherum avenaceum, Beauv.
Melica nutans, L.
M. uniflora, Retz.
**Bromus ramosus*, Huds.
**Brachypodium gracile*, Beauv.
**Agropyron caninum*, Beauv.
Pteris aquilina, L.
Athyrium Filix-fœmina, Roth.

The plants peculiar to the old pine forests are almost as few and as rare as in Midlothian district. The following are given in White's *Flora* for this part of Perthshire :—

Linnæa borealis, L.—Near Killin. Curiously enough this species does not seem to be reported for the Black Wood of Rannoch, where it certainly might well be expected.
Pyrola minor, L.—Frequent.
P. media, Sw.—Frequent.
P. rotundifolia, L.—"Dunkeld" (1840), Blair Atholl (?)
P. secunda, L.—In several localities.
Trientalis europæa, L.—Frequent.
Corallorhiza innata, Br.—Black Wood of Rannoch.
Listera cordata, Br.—Frequent.
[*Moneses grandiflora*, Gray, and *Goodyera repens*, R. Br., although found in other parts of Perthshire, do not seem to be present within the area of the present map.]

Three species which I have found quite commonly in the pine woods in Norway, and which might be expected in the present woods, are here entirely confined to the Alpine region. These are—*Cornus suecica*, L., *Vaccinium uliginosum*, L., and *Lycopodium annotinum*, L. The last named has been found in an adjoining district, inhabiting a wood near Blairgowrie (9), a piece of evidence favouring the theory of the former presence of this species at least, in the primitive woods of Perthshire, when they more nearly resembled those of Norway at the present day.

Several of the woodland plants may be found within the Alpine region, above 2000 feet (608 metres), where the shelter of rocky ravines or crevices, or of heather or blaeberry, replaces that of the trees at lower

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elevations. The chief of these are given here, along with the highest altitudes recorded for them in White's *Flora*.

Anemone nemorosa, L.	(2750 feet.)	*Pyrola minor*, L.	(3700 feet.)
Viola Riviniana, Reich	(2800 „)	*Vaccinium Myrtillus*, L.	(3900 „)
Lychnis dioica, L.	(2500 „)	*Lysimachia nemorum*, L.	(2700 „)
Hypericum pulchrum, L.	(2700 „)	*Trientalis europœa*, L.	(2500 „)
Geranium sylvaticum, L.	(3000 „)	*Veronica Chamædrys*, L.	(2400 „)
Oxalis Acetosella, L.	(2800 „)	*Melampyrum pratense*, L.	(3000 „)
Spiræa Ulmaria, L.	(2900 „)	*Mercurialis perennis*, L.	(3300 „)
Rubus Idæus, L.	(2450 „)	*Urtica dioica*, L.	(2750 „)
R. saxatilis, L.	(3200 „)	*Listera cordata*, R. Br.	(2500 „)
Geum rivale, L.	(3000 „)	*Luzula maxima*, DC.	(2800 „)
Pyrus Aucuparia, Ehoh.	(2850 „)	*L. campestris*, DC.	(3000 „)
Angelica sylvestris, L.	(2800 „)	*L. erecta*, Desv.	(3350 „)
Adoxa Moschatellina, L.	(3000 „)	*Poa nemoralis*, L.	

and most of the species of ferns found in the district.

Region of Hill Pasture and Moorland.

(Region of Sub-Arctic or Sub-Alpine Europe.)

The limits of this region are more difficult to define here than in the Edinburgh district. There it extends from the borders of cultivation to the highest point of the hills, an altitude which only reaches 2136 feet (649 metres). In the present district the range of altitude is much greater, and the vegetation undergoes considerable change in character towards the highest points; grasses and heather, the species we have regarded as characteristic of the region of hill pasture and moorland, being replaced by mosses, lichens, dwarf willows, sedges, saxifrages, etc. —in short, the vegetation designated as Alpine. The transition between the regions is, however, gradual, and consideration is required before deciding upon the separating characters. In other countries the transition to the Alpine region is usually indicated by the disappearance of the trees. By applying this rule to the present district, we should get somewhere about 2000 feet (608 metres) as the beginning of the Alpine region. Although from the great scarcity of trees such a determination must be regarded as only approximate, still there are other circumstances which show that this figure is of value. A number of the heather associates, in particular *Erica Tetralix*, L., and *E. cinerea*, L., cease about this altitude. *Vaccinium Myrtillus*, L., which below 2000 feet is usually quite a subordinate species, above this begins, on many hills, to be a conspicuous element in the vegetation. *Alchemilla alpina*, L., one of the most characteristic Alpine species, also becomes much more abundant above 2000 feet. On some mountains these changes towards the Alpine condition begin lower than on others, but as the differences in this respect are usually too slight to be shown on a map of the present scale, the contour line of 2000 feet (608 metres) has been used to define the upper limit of the region of hill pasture and moorland.

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Here, as on the Pentland hills, a strong contrast can be seen between the green pasture and the brown heather. The Breadalbane range is a good example of the green type, and the Rannoch mountains of the brown. These two types have been distinguished by different colours on the map, so that the area occupied by each may be compared with the formations shown on the geological maps. As in Midlothian the differences in vegetation seem to be mainly due to differences in the physical and chemical nature of the subjacent rock and soil.

The mineral content of the soil plays an important part in determining the association inhabiting it. Where the soil is poor in mineral salts, such as that formed by the disintegration of sandstones or quartzitic rocks, or that composed of almost pure peat, the plant association is poor in number of species, and heather and its associates predominate. Thus if the botanical map be compared with the geological map, it will be seen that the greatest areas of heather coincide with the poor quartzitic hills of Rannoch and Atholl, whilst the greatest areas of pasture, on the other hand, coincide with rich schists, containing calcium, magnesium, and potassium, of the Breadalbane range. Beinn a' Ghlo, Beinn a' Chuallaich, Beinn Mholach, and Schiehallion are all good examples of the heather type on quartzitic rocks; Ben Lawers, and the hills north of Kirkmichael of the grassy type on limestones, and chloritic and mica schists. Some of the smaller patches of pasture occur closely associated with outcrops of limestone, as, for example, beside Loch Moraig, on Tulach hill above Blair Atholl, around Loch Tummel, and in Glen Lyon. In some other cases, such as in Glen Tilt, the chemical nature of the soil does not seem so important in producing the grass association as the regular conditions of moisture on the well-drained slopes of the narrow valley.

The conditions of development of the heather association, shortly stated, seem to be the presence of a peaty soil poor in mineral content, which may be dry and unretentive, or wet and stagnant. The grasses, on the other hand, require a soil rich in minerals which is well-drained on the surface, and with a retentive bottom layer.

There are still, however, other causes which determine the presence of heather or of grass. Thus much of the hill-land adjoining cultivation is pasture, and has evidently been produced from the heather area through the manuring, regular cropping, and treading of the sheep. Regular burning seems in certain parts, on the other hand, to have increased the area dominated by the heather. These, however, I believe to be quite secondary causes, and to act rather towards emphasising the natural contrast between the types than to greatly alter the areas of distribution.

Fuller discussion of these questions I reserve for a paper dealing with a wider area than is here being studied.

Heather Association.

This is by far the most characteristic association of the district. In many parts it extends as an almost unbroken covering to the hills. Here as elsewhere it requires a peaty soil for its development. Sometimes this may be a mere surface film a few inches thick, resulting from

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the partial decay of species of *Dicranum*, *Hypnum*, or *Racomitrium*, mosses which grow freely on the drier quartzitic mountains of Perthshire, such as Schiehallion and Beinn a' Ghlo, or again it may be a peat layer several feet in thickness, formed mainly from *Sphagnum*, which has grown in the moorland hollows.

The exact part played by this peat in the economy of the heather plant is still doubtful. Microscopic examination of the roots shows, however, that root-hairs are wanting, and that the rootlets are closely invested by the filaments of a fungus, which also penetrates their epidermal cells. There may be some sort of co-operation between this root-fungus (*mycorhiza*), and the heather plant that enables the heather to utilise the food-stuffs of the peculiar humus in which it grows. Be this as it may, it is enough for our present purpose to recognise that the presence of the peat with the associated mycorhiza is an important factor in determining the area of distribution of the heather plant.[1]

The following associates of the heather agree with it in requiring humus for their development, and in a number of these at least—the *Ericaceæ*, *Orchideæ*, and *Empetrum*—a *mycorhiza* has similarly been found in connection with their roots:—

Peat plants in dry conditions.	Peat plants in moist conditions.
Potentilla silvestris, Neck.	**Rubus Chamæmorus*, L. (Alpine).
Antennaria dioica, R. Br.	**Schollera Oxycoccus*, Roth.
Vaccinium Vitis-Idæa, L.	*Erica Tetralix*, L.
V. uliginosum, L. (Alpine).	*Myrica Gale*, L.
V. Myrtillus, L.	*Empetrum nigrum*, L.
Arctostaphylos Uva-ursi, Spreng.	**Malaxis paludosa*, Sw.
Calluna Erica, DC.	*Juncus squarrosus*, L.
Erica cinerea, L.	**Rhynchospora alba*, Vahl.
**Loiseleuria procumbens*, Desv. (Alpine).	**Carex magellanica*, Lam.
**Pyrola rotundifolia*, L. (Alpine).	**C. limosa*, L.
**P. media*, Sw.	*Molinia varia*, Schrank.
**P. minor*, L.	
**P. secunda*, L. (Alpine).	
Listera cordata, R. Br.	
Nardus stricta, L.	
Lomaria Spicant, Desv.	

This list hardly differs from that given for the Midlothian district, a fact which testifies to the constancy of this association over a considerable area.

With the exception of the rare or Alpine species, distinguished by an asterisk, the plants of the above list may be regarded as constantly associated with the heather. They occur in almost every one of the many lists of associates which I have compiled from all parts of the

[1] For further information on mycorhiza the reader is referred to Frank's *Lehrbuch der Botanik*, vol. i. p. 264, etc., Leipzig (Engelmann), 1892.

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heather area. Several others occur in almost as many of these lists, and are characteristic plants of the association, although by no means confined to it, some being almost as abundant in the pasture area. The chief of these characteristic species are :—

Anemone nemorosa, L.
Ranunculus acris, L.
R. repens, L.
Viola Riviniana, Reich.
Polygala vulgaris, L.
Hypericum pulchrum, L.
Linum catharticum, L.
Oxalis Acetosella, L.
Genista anglica, L.
Lotus corniculatus, L.
Lathyrus montanus, Bernh.
Galium saxatile, L.
Scabiosa Succisa, L.
Gnaphalium sylvaticum, L.
Achillea Ptarmica, L.
Crepis virens, L.
Hieracium Pilosella, L.
Campanula rotundifolia, L.
Trientalis europæa, L.
Veronica officinalis, L.
Melampyrum pratense, L.
Euphrasia officinalis, L.
Thymus Serpyllum, L.
Rumex Acetosa, L.
R. Acetosella, L.
Salix aurita, L.
S. repens, L.
Orchis maculata, L.
Habenaria conopsea, Benth.
Juncus conglomeratus, L.
Luzula campestris, DC.
Scirpus cæspitosus, L.
Eriophorum vaginatum, L.
E. angustifolium, Roth.
Carex echinata, Murr.
C. Goodenowii, J. Gay.
C. pilulifera, L.
C. binervis, Sm.
Anthoxanthum odoratum, L.
Agrostis vulgaris, With.
Deschampsia flexuosa, Trin.
Avena pratensis, L.
Sieglingia decumbens, Bernh.
Festuca ovina, L.
Lastræa Filix-mas, Presl.
L. dilatata, Presl.
Lycopodium Selago, L.
L. clavatum, L.
L. alpinum, L.

While considering the heather association on the Pentlands, it was shown that three well-marked varieties could be distinguished, namely, heath, heather-moor, and *Sphagnum*-moor. The same three varieties are represented in the present district. The driest variety, heath, occurs on those hills with a poor and unretentive soil, especially on steep slopes with a southern exposure. It is well marked on the Rannoch hills, on Beinn a' Ghlo, and on parts of Schiehallion. It can be easily recognised by the presence of *Erica cinerea*, *Antennaria*, *Arctostaphylos*, *Genista*, *Potentilla silvestris*, etc. On wetter localities, especially poorly drained slopes facing the north, such as also occur frequently amongst the Rannoch mountains, the association takes the form designated heather-moor. *Erica Tetralix*, *Molinia varia*, *Scirpus cæspitosus*, *Juncus squarrosus*, and in the lower parts *Myrica Gale* are the species by which it is indicated. With extreme moisture the heather-moor passes into the "*Sphagnum*-moor," where living *Sphagnum*, sedges, *Empetrum*, *Eriophorum*, etc., constitute the dominant vegetation. This association reaches a great development in the wild moor of Rannoch lying to the west of the area we are considering. It is found in all the peat-bogs within our area, and the chief of these which are already represented on the one-

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inch map of the Geological Survey have been differently coloured on this map to distinguish them from the general heather association.

The variety of the heather-moor characterised by the abundance of the bog-myrtle (*Myrica Gale*) occurs particularly on the lower slopes of the valleys, especially on the badly drained clearings in the birch woods. It is largely made up of marsh species, being transitional in some ways between the heather-moor and the true marsh associations. The following list from a clearing near Loch Tummel will show its general composition:—

Ranunculus Flammula, L.
Viola palustris, L.
Potentilla silvestris, Neck.
Drosera rotundifolia, L.
Scabiosa Succisa, L.
Calluna Erica, DC.
(Not common.)
Erica Tetralix. (Abundant.)
Pinguicula vulgaris, L.
Habenaria conopsea, Benth.
Narthecium Ossifragum, Huds.
Juncus lampocarpus, Ehrh.
J. acutiflorus, Ehrh.
Eriophorum vaginatum, L.
Carex pulicaris, L.
C. echinata, Murr.
C. ovalis, Good.
C. flacca, Schrel.
C. flava, L.
Molinia varia, Schrank.
(Most abundant species after *Myrica Gale*.)
Sphagnum, spp.

Grass Associations.

The grassy covering of the hills varies considerably in composition according to the particular conditions present, and quite a number of different grasses may predominate. The good mountain pasture is mainly composed of *Agrostis canina*, L., *A. vulgaris*, With., *Anthoxanthum odoratum*, L., and *Festuca ovina*, L. On the best pastures, especially those near the borders of cultivation, these species are largely mixed with such finer grasses as *Poa pratensis*, L., *P. trivialis*, L., and *Cynosurus cristatus*, L. *Nardus stricta*, L., approaches the heather in its requirements, as it seems to grow best on dry, poor soil, with a certain amount of peat always present. It forms an association in some ways intermediate between the heath and the dry pasture. The association dominated by *Molinia varia*, Schrank, is, on the other hand, intermediate between the heather-moor and the wet pasture, as it seems to prefer a wet, ill-drained peaty soil. *Deschampsia* (*Aira*) *cæspitosa*, Beauv., *D. flexuosa*, Trin., and *Holcus lanatus*, L., are all characteristic of disturbed ground, such as clearings in woods; the first occurs particularly where the soil is clayey and wet, the second where it is dry and peaty, the third on the better-drained clearings.

A good example of the *Deschampsia flexuosa* association may be seen in the clearings of the pine and larch woods, such as occur above Blair Atholl. On one such clearing, near Loch Moraig, with a dry sandy soil, the ground which has been most disturbed is mainly peopled by—

Deschampsia flexuosa, Trin.
Holcus lanatus, L.
Ranunculus acris, L.
Rubus idæus, L.
Cnicus lanceolatus, Willd.
Veronica Chamædrys, L.
Rumex Acetosella, L.
Urtica dioica, L.

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The grass species second in importance on this clearing is *Festuca ovina*, L., which seems to be gradually replacing the dominant *Deschampsia flexuosa*. With it are associated such pasture species as—

Viola Riviniana, Reich.
Cerastium triviale, Link.
Rosa canina, L. (seedlings).
Galium saxatile, L.
Scabiosa Succisa, L.
(in moister parts).
Veronica officinalis, L.
V. Chamædrys, L.
Luzula vernalis, DC.
L. campestris, DC.

Mixed with this pasture is a good deal of small heather which may, on the poorest parts, replace the grasses. Where it grows it is usually associated with—

Polygala vulgaris, L.
Potentilla silvestris, Neck.
Erica cinerea, L.
Hypnum Schreberi, L.

A few species characteristic of shady places manage to compete with the invading species, as, for example—

Anemone nemorosa, L.
Spiræa Ulmaria, L.
Rubus saxatilis, L.
Trientalis europæa, L.

Seedlings of birch, in most cases browsed down near to the ground by sheep or rabbits, are struggling to reinstate the arborescent vegetation.

The general flora of the pasture area is large. It includes almost all the species of the heather area and many others besides. The complete list may be easily constructed from White's *Flora of Perthshire* (9). Here two type lists will be given, one from the south slopes of Ben Lawers between 1000 and 1500 feet (304 to 456 metres), and the other from pasture above limestone rock near Balnabodach on Loch Tummel.

Pasture plants on south slopes of Ben Lawers, between 1000 and 1500 feet :—

Gramineæ :—

Chief species.
**Anthoxanthum odoratum*, L.
**Agrostis vulgaris*, With.
A. canina, L.
**Festuca ovina*, L.
**Deschampsia flexuosa*, Trin.
Sieglingia decumbens, Bernh.
Cynosurus cristatus, L.
**Molinia varia*, Schrank.
Poa pratensis, L.
**Nardus stricta*, L.

Other families :—

**Ranunculus acris*, L.
R. repens, L.
R. bulbosus, L.
**Viola Riviniana*, Reich.
Polygala vulgaris, L.
**Sagina procumbens*, L.
**Linum catharticum*, L.
Trifolium pratense, L.
**T. repens*, L.
**Lotus corniculatus*, L.

* Also found in the Alpine pasture between 2000 and 3000 feet (608 to 912 metres) on Ben Lawers.

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**Lathyrus montanus*, Bernh.
**Potentilla silvestris*, Neck.
**Alchemilla vulgaris*, L.
Pyrus Aucuparia, Ehrh. (seedlings).
**Galium saxatile*, L.
**Scabiosa Succisa*, L.
**Bellis perennis*, L.
Habenaria viridis, R. Br.
H. bifolia, R. Br.
**Narthecium Ossifragum*, Huds.
**Juncus squarrosus*, L.
**Luzula campestris*, DC.
**Achillea Millefolium*, L.
Hieracium Pilosella, L.
**Taraxacum officinale*, Web.
**Campanula rotundifolia*, L.
**Vaccinium Myrtillus*, L. (small and scattered).
**Calluna Erica*, DC. (small and scattered).
Erica cinerea, DC. (small and scattered).
Gentiana campestris, L.
Veronica officinalis, L.
**Euphrasia officinalis*, L.
**Thymus Serpyllum*, Fr.
Prunella vulgaris, L.
**Plantago lanceolata*, L.
**Rumex Acetosa*, L.
**R. Acetosella*, L.
**Orchis maculata*, L.
Habenaria conopsea, Benth.
H. albida, R. Br.
**Scirpus cæspitosus*, L.
**Carex pilulifera*, L.
Pteris aquilina, L. (scattered).

Pasture plants near Balnabodach, Loch Tummel, with lime in soil. Altitude 700 to 900 feet (213 to 274 metres)[1]:—

Graminea:—

Kœleria cristata, Pers.
Cynosurus cristatus, L.
Festuca ovina, L.
Poa pratensis, L.
Holcus lanatus, L.

Other plants:

Helianthemum Chamæcistus, Mill.
Polygala vulgaris, L.
Trifolium pratense, L.
T. repens, L.
T. dubium, Sibth.
Lotus corniculatus, L.
Rubus fruticosus, L.
Alchemilla vulgaris, L.
Rosa, sp.
Galium verum, L.
Galium saxatile, L.
Bellis perennis, L.
Chrysanthemum Leucanthemum, L.
Hieracium Pilosella, L.
Gentiana campestris, L.
Euphrasia officinalis, L.
Thymus Serpyllum, L.
Plantago lanceolata, L.
Pteris aquilina, L. (scattered).

In comparing the region of hill pasture and moorland of Perthshire with the same region on the Pentlands, the close agreement in the flora and in the relative importance of the species in the associations is very marked. The highland region is richer in species and bears fewer traces of human influence, but the dominant heaths and grasses are almost the same in both cases.

Two species of the heather association, *Vaccinium Vitis-Idæa* and *Arctostaphylos Uva-ursi*, which are common in the Highlands, are rare in the lowland area, the second being quite absent from the Pentlands.

[1] This list does not pretend to be so complete as the other, but only aims at showing the chief species of the association.

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Myrica Gale, likewise rare in the lowland district, is one of the characteristic plants of the Highland valleys, increasing in importance the farther we penetrate into the mountains towards the west. On the other hand, the Cranberry, *Schollera Oxycoccus*, which is comparatively common in some of the peat bogs of the Pentlands, seems to be very rare in the present area.

The bracken (*Pteris aquilina*) is better developed on the slopes facing the south than on those facing the north, although it is most luxuriant under the shade of the birch-trees. It reaches altitudes similar to those attained on the Pentlands, in general ceasing about 1400 feet (426 metres). Dr. Buchanan White (9), however, records it as high as 1550 feet (471 metres) in Breadalbane, and 1800 feet (547 metres) in Rannoch. The bell heath (*Erica cinerea*) is like the bracken in growing best with a southern exposure; it is particularly well-developed on the dry quartzitic hills.

The mountain buckler fern (*Lastræa Oreopteris*) is quite characteristic of steep valley slopes shut off from the direct rays of the sun. Thus it is well developed in Glen Tilt, and in Glen Leathad (a branch of Glen Tilt) it almost completely covers the slopes facing north-east.

The matweed (*Nardus stricta*), which is very abundant in the drier hollows of the Pentlands, seems rather less abundant in the Highland area.

Alpine Region.

As already stated, the Alpine region may be regarded as beginning at 2000 feet (608 metres), about which altitude the last of the trees are found, and a number of the characteristic sub-Alpine pasture and moorland species cease. The changes, however, are usually gradual, and it is often about 3000 feet (912 metres) before the Alpine features of the landscape become conspicuous. Between 2000 and 3000 feet the vegetation is generally a poor pasture or moorland, with patches of Alpine species at the sources and on the sides of the streams, or in the shelter of the crags.

An even sharper contrast than in the sub-Alpine region is here seen between the poor Rannoch and the rich Breadalbane mountains, for now the subjacent rocks contribute more to the actual surface soil, being less covered up by superficial glacial deposits. Three main types of mountain between these altitudes have been distinguished on the map. The first is grassy, with an association of plants hardly differing from the pasture of the sub-Alpine region except in the abundance of its characteristic species (*Alchemilla alpina*, L.). It includes all the Breadalbane mountains, and on the map no distinction in colour has been made between it and the sub-Alpine pasture. On Ben Lawers many of the species, which elsewhere cease below 2000 feet, here mount nearly to 3000 feet. On the list given above for Ben Lawers those hill pasture species, which also occur in the Alpine region, are marked with an asterisk. They constitute more than half the number.

The second type of mountain is also largely covered with grasses, but with the blaeberry (*Vaccinium Myrtillus*) very much mixed with them,

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and still little heather. This has been distinguished on the map by a special colour, and will be seen to cover several of the Atholl and Glen Almond mountains, such as Ben Vrackie, Farragon, Auchnafree, etc. Ben Vrackie and Farragon resemble Ben Lawers very closely in their geological structure, and were they only of greater altitude might be expected to have a similar vegetation, with grasses dominating over *Vaccinium*.

The third type is still poorer. Grasses are here relatively rare, and peat plants in contrast dominate. Heather, although abundant, is nowhere in very good condition, and is partly superseded as dominant species by *Vaccinium Myrtillus*. This mixture has been indicated on the map by colouring this association the same as that of *Vaccinium Myrtillus*, and dotting the heather colour over it.

The species of the heather association which I have found still lingering on in the Alpine region are given in the following list. To each species is added the highest altitude at which it has been recorded in Rannoch or Atholl; the figures have been taken from White's *Flora*, except in a few cases (indicated by the initials R. S.) where I have found the species at higher altitudes than are given in that work:

Hypericum pulchrum, L.	2600 ft.	*Salix aurita*, L.	2600 ft.
Oxalis Acetosella, L.	3000 „	*S. repens*, L.	2800 „
Lotus corniculatus, L.	2800 „	*Empetrum nigrum*, L.	3600 „ (R.S.)
Potentilla silvestris, Neck.	2900 „	*Orchis maculata*, L.	2650 „
Galium saxatile, L.	2700 „ (R.S.)	*Juncus squarrosus*, L.	3000 „
Scabiosa Succisa, L.	2600 „	*Luzula campestris*, DC.	
Antennaria dioica, R. Br.	2850 „	*Eriophorum vaginatum*, Roth.	3000 „
Campanula rotundifolia, L.	3000 „	*Carex pilulifera*, L.	2850 „
Vaccinium Myrtillus, L.	3600 „ (R.S.)	*C. binervis*, Sm.	2600 „
V. Vitis-Idæa, L.	3540 „	*Anthoxanthum odoratum*, L.	2800 „
Arctostaphylos Uva-ursi, Spreng.,	2350 „	*Agrostis vulgaris*, With.	2600 „ (R.S.)
Calluna Erica, DC.	3100 „	*Deschampsia flexuosa*, Trin.	3700 „
Pyrola minor, L.	over 2000 ft. (R.S.) 3700 in Breadalbane.	*Festuca ovina*, L.	"at all levels"
Euphrasia officinalis, L.	3000 ft.	*Nardus stricta*, L.	2600 ft. (R.S.)
Melampyrum pratense, L.	3000 „	*Lomaria Spicant*, Desv.	3000 „
Thymus Serpyllum, L.	2850 „	*Lastræa dilatata*, Presl.	3450 „
Rumex Acetosa, L.	3757 „	*Lycopodium Selago*, L.	3600 „ (R.S.)
R. Acetosella, L.	3300 „ in Breadalbane.	*L. clavatum*, L.	2760 „
		L. alpinum, L.	3547 „

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In addition to those species certain others are found which are almost peculiar to the heather and *Vaccinium* association between 2000 and 3000 feet. The chief of these are :—

Rubus Chamæmorus, L.
Cornus suecica, L.—This species, as has already been pointed out by Dr. White (9), is in almost all its stations associated with *Vaccinium Myrtillus*, L.
Vaccinium uliginosum, L.
Loiseleuria procumbens, Desv.
Betula nana, L.
Lycopodium annotinum, L.

Above 3000 feet (912 metres), and even on bare exposed places at lower elevations, such as the summits of hills, the ground is usually stony and sparsely covered with vegetation. Mosses and lichens dominate, in particular the woolly fringe-moss (*Racomitrium lanuginosum*), which on many of the steep mountain rubbles or "screes" forms the peat on which the Alpine humus plants develop. Stunted plants of *Empetrum*, *Vaccinium* spp., *Lycopodium Selago*, are still frequent, and in addition certain species peculiar to these mountain ridges, such as—

Potentilla Sibbaldi, Hall, *fil.*
Gnaphalium supinum, L.
Salix herbacea, L.
Carex rigida, Good.

The characteristic Alpine flora is, however, mainly confined to the sheltered crags and wet places about 3000 feet. Its distribution, like that of the Alpine pasture and moorland, seems largely to depend on the physical and chemical nature of the rock giving rise to the soil. The comparative wealth of the Breadalbane range in Alpine species has long been well known, and as was pointed out by Mr. P. Macnair (6) in 1898, the richest area corresponds to certain strata of sericite (chloritic) schist which run in a south-west to north-east direction through this district.

The following tables will illustrate the distribution of the Alpine flora throughout the district included in the map. Most of the localities required for their preparation have been obtained from White's *Flora* :—

I. Species found on all three classes of mountain shown on the map, which are, however, most abundant on the Ben Lawers type.

Thalictrum alpinum, L.
Draba incana, L.
Cochlearia officinalis, var. *alpina*, Wats.
Silene acaulis, L.
Potentilla rubens, Vill.
P. Sibbaldi, Hall, *fils.*
Alchemilla alpina, L.
Saxifraga oppositifolia, L.
S. stellaris, L.
S. aizoides, L.
S. hypnoides, L.
Sedum roseum, Scop.
Epilobium alsinefolium, L.
E. anagallidifolium, Lam.
Cornus suecica, L.
Galium sylvestre, Poll.
Gnaphalium supinum, L.
Saussurea alpina, DC.
Vaccinium uliginosum, L.
Loiseleuria procumbens, Desv.
Oxyria digyna, Hill.

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Betula nana, L.
Salix Lapponum, L.
S. herbacea, L.
Tofieldia palustris, Huds.
Juncus trifidus, L.
J. triglumis, L.
Luzula spicata, DC.
Carex pauciflora, Lightf.
C. rigida, Good.
Poa alpina, L.
Aspidium Lonchitis, Sw.
Pseudathyrium alpestre, Newm.

II. Species almost or quite confined to the Ben Lawers type of mountain.

Arabis petræa, L.
Draba rupestris, Br.
Erophila vulgaris, var. *inflata*, Hook. Also in Rannoch (9).
Cochlearia micacea, Marshall.
Cerastium alpinum, L. Also in Atholl (9).
C. arcticum, Lange.
C. trigynum, Vill.
Arenaria verna, L.
A. sulcata, Schlecht.
Cherleria sedoides, L.
Sagina Linnæi, Presl.
S. nivalis, Fr.
Oxytropis uralensis, DC. Also on Ben Vrackie (9).
Dryas octopetala, L. Also in Glen Tilt.
[Chiefly on calcareous rocks(9)].
Saxifraga nivalis. Rare in Rannoch (9).
Saxifraga rivularis, L.
S. cernua, L.
S. grœnlandica, L.[1]
S. quinquefida, Haworth.
Sedum villosum, L.
Erigeron alpinum, L.
Gentiana nivalis, L.
Myosotis alpestris, Schmitt.
Veronica alpina, L. Also from Glen Tilt, and near Dalnaspidal (9).
V. fruticans, Jacq. Also from Glen Tilt (9).
Bartsia alpina, L.
Salix Arbuscula, L.
S. lanata, L.
S. Myrsinites, L. Also from Schiehallion, Craig Challeach, and Blair Atholl (9).
S. reticulata.
Juncus alpinus. Also from the Atholl Mountains (9).
J. castaneus, Sm.
J. biglumis, L.
Kobresia caricina, Willd. Also on Ben Vuroch [Brebner (9)].
Carex rupestris, All.
C. alpina, Sw.
C. atrata, L. Also on Farragon (9).
C. ustulata, Whnl.
C. pulla, Good.
C. Grahami, Boott.
Phleum alpinum, L.
Deschampsia alpina, R. and S. Also on Beinn a' Ghlo (9).
Sesleria cærulea, Ard.
Poa glauca, Sm.
P. Balfourii, Parnell.
Woodsia hyperborea, Br.
Cystopteris montana, Link.
Pseudathyrium flexile, Newm.

III. Species not found on the Ben Lawers type of mountain.

Thlaspi alpestre, L.—Beinn a' Chuallich, on limestone (9).
Astragalus alpinus, L.—Ben Vrackie (9). This mountain approaches very nearly the Ben Lawers type.
Phyllodoce cærulea, Bab.—Sow of Atholl (9).
Alopecurus alpinus, Sm.—Glen Tilt (9).

[1] Ben Lawers (Druce, *Ann. Scott. Nat. Hist.*, 1898, p. 243).

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The two districts which have now been surveyed—Edinburgh and North Perthshire—taken together furnish us with representative examples of all the main types of vegetation to be found in Scotland. They include between them all the altitudinal regions, and further survey in other parts can only be expected to add to the number of the minor plant associations dependent on other factors than altitude. It may thus be convenient to give the following summary of the regions and plant associations represented in the two districts:—

I. Littoral Region (represented only on the Edinburgh district map).
- *a.* Submerged vegetation.
- *b.* Salt marshes.
- *c.* Seaside rocks.
- *d.* Sandy shores and dunes.
- *e.* Seaside "links" or fixed dunes.

II. Temperate Region, 0 to 1000 feet (0 to 304 metres).
- *a.* Region of Cultivation.
  1. With wheat cultivation, upper limits 500 to 600 feet (152 to 182 metres).
  2. Without wheat cultivation, upper limits 1000 to 1250 feet (304 to 380 metres).
- *b.* Region of Deciduous Trees, mainly Oak and Beech.
  1. Mixed Deciduous Woods, including Beech—
     Upper limits in Edinburgh district 800 to 1000 feet (243 to 304 metres).
     Upper limits in North Perthshire 700 to 900 feet (213 to 274 metres).
  2. Oak Woods—
     Upper limits in North Perthshire 900 to 1000 feet (274 to 304 metres).

III. Sub-Alpine Region, 1000 to 2000 feet (304 to 608 metres).
- *A.* Region of Coniferous and Birch-Trees.
  1. Scots Pine Woods—
     Upper limits in Edinburgh district 1250 to 1500 feet (380 to 456 metres).
     Upper limits in North Perthshire 1500 to 1800 feet (456 to 547 metres).
     Isolated trees at 1900 feet (578 metres), (9).
  2. Larch Woods—
     Upper limits in North Perthshire 1300 to 1800 feet (395 to 547 metres).
  3. Birch Woods—
     Upper limits in North Perthshire 1500 to 2000 feet (456 to 608 metres).
     Isolated trees at 2300 feet (699 metres) (R.S.).

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B. Region of Hill Pasture and Moorland.

a. Heather associations—
Erica cinerea and *E. Tetralix* (characteristic species) cease at an altitude of 2200 feet (669 metres), (9).

b. Pasture associations.

IV. Alpine Region, 2000 to 4000 feet (608 to 1216 metres).

[In Edinburgh district represented only by a few isolated species.]

a. Heather associations.—*Calluna* ceases at 3100 feet (942 metres), (9).
b. *Vaccinium Myrtillus* association.—Ceases 3600 feet (1094 metres), (R.S.).
c. Pasture associations.
d. Alpine plateau with mosses, lichens, etc.
e. Alpine crags.

One of the aspects of this survey which I intend to consider in detail in a future paper is the light which it throws on the relations between the vegetation of Britain and that of neighbouring European countries. With this end in view the regions and associations have been compared throughout with those described in the works of such authorities as Andersson, Blytt, Christ, Drude, Flahault, Hult, Warming, etc., and where possible have been designated by similar names.

It was with some degree of hesitation that I decided to publish this second sheet, since, owing to the nature of the country and the prevailing climatic conditions, a uniform accuracy of detail in the survey of such an extensive area cannot be obtained without much labour and a considerable expenditure of time. To reduce or remove any error that might have arisen from this cause, I have made out lists of questions concerning the more difficult areas, and have sent them to correspondents in the district capable of making the requisite observations. In this way I have obtained two or more reports on each doubtful area, and with these have checked my own notes. Some errors are undoubtedly still to be found, but I trust they are small and do not affect the main features of the survey.

It is necessary to note, that for the employment of this map in the field some little practice will be required to read the different aspects of the landscape. Thus, for example, a hill, which as seen from one part on it, may appear heather-clad, may be found when viewed as a whole, or when traversed and carefully examined, to be really of the grassy type. The character of a doubtful hill has usually to be judged, both by a series of classified lists made at different parts, and by the general aspect as seen from a neighbouring hill.

For assistance in making observations or in distributing my lists of questions I have to thank the following ladies and gentlemen :—Miss M'Farlane, Turrerich, Glen Quaich; Mrs. A. Reid, Trinity College, Glen Almond; Mr. Alex. Farquharson, Bridgend of Straloch; Mr. R. N. Kerr,

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A JOURNEY THROUGH SOMALILAND AND SOUTHERN ABYSSINIA TO THE SHANGALLA OR BERTA COUNTRY AND THE BLUE NILE, AND THROUGH THE SUDAN TO EGYPT.

By REGINALD KOETTLITZ, M.R.C.S.Eng., L.R.C.P.Edin.

ABYSSINIA, the ancient Ethiopia, historically a land of many mysteries, which contains one of the sources of the Nile, the land of many glorious mountains and the seat of tremendous volcanic activity within geologically recent times, the highlands and Switzerland of Africa, had always had a great attraction for me; therefore, when I was offered an opportunity for visiting it, the offer was too tempting to refuse, and when it was also proposed that we should travel across the southern, less visited portion, from east to west, and return *vid* the Sudan and Egypt, it could not be resisted.

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Mr. Weld Blundell's expedition consisted of five white men: himself; Lord Lovat his nephew; Mr. Harwood a taxidermist; a valet to act as camp major-domo; and myself. Our coloured attendants were numerous and varied in number.

The objects were to map the country, especially the portions which had not been visited before by white men; to investigate the geological formation, make zoological collections, especially an ornithological one; and make as many anthropological and ethnological observations as possible. It was proposed that we should travel continuously, so that we should get back again in about six months.[1]

Mr. Weld Blundell had been in the country before, having in fact returned from Addis Abbaba in the July previous. He had accompanied Captain Harrington, the British representative to the court of King Menelik, upon his journey to Addis Abbaba for the purpose of establishing the Agency there and presenting his credentials to the King. The experience gained upon that journey gave him the requisite knowledge as to how to proceed, and enabled him to make all the necessary preparations, in the most expeditious manner, for the journey we now proposed to make. We met at Aden at the end of November 1898, and after some days occupied in hiring Somali servants, buying a few more necessaries, waiting for our baggage from England, which had been delayed, writing letters, as well as making arrangements for crossing the Gulf of Aden, we crossed to Berbera on the Somali coast. There we hired camels for our caravan, bought ponies and mules, as well as hired more Somali servants, and on December 6th we started upon the first stage of our journey, to Harrar.

Berbera was selected as our starting-point, so that we might avoid the long, monotonous, hot, and disagreeable desert route from Zeyla, which is the usual and nearest port for Harrar; for though the distance from Berbera is forty miles longer, yet as our road passed through so much more varied, more elevated, and therefore cooler country, where game also was more plentiful, it was thought that we should thus be compensated for the greater distance we had to traverse. Part of our baggage and supplies were forwarded by the regular supply caravan *viâ* Zeyla to meet us at Harrar, while a further supply was to go on to Addis Abbaba. Notwithstanding this, however, when we left Berbera our caravan consisted of some thirty-five pack camels, with eighteen attendant drivers, our head man, ten personal servants, four Sudanese soldiers (who had fought at the battle of Omdurman, and who had just got back to Cairo, where Mr. Weld Blundell hired them) to act as escort, a donkey as bait for lions, should we come across any, some sheep and goats, for food on the journey, besides the four ponies and a mule which carried us.

Berbera town, as is well known, consists of two portions about a mile apart. It is situated upon the coast, and built upon the low-lying coral-sand desert which fringes the coast everywhere here, and which has

[1] As a matter of fact, on account of unavoidable delays, the journey occupied eight months.

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evidently comparatively recently risen above sea-level; a spit of sand juts out into the sea and encloses a shallow bay, which forms a fairly good harbour.

The western and better-built portion is where the British Resident resides: here also are the travellers' rest-house or bungalow, the barracks, post-office, mosque, hospital, besides other stone and sun-dried brick buildings, built by the Egyptians when they occupied the country. The eastern part of the town is where the merchants' offices and Jewish and other tradesmen's bazaars are, as well as where the natives live; between

Berbera Mosque.

the two are the temporary encampments of the caravans of the natives from the interior. In this native encampment I had an opportunity of seeing the Midgan blacksmiths and artificers at work.[1] They were making spears, Somali swords, axes, knives, and many other things. Their forge was constructed after the widespread African method: the fire made in a hole in the ground, down to which an earthenware tube led, which was connected with two wide-mouthed jars; to these, in order to close them, loose leather bags were firmly attached all round the edges. To the centre of these bags vertical sticks were fastened, and these being alternately raised and lowered by the man operating with them, a

[1] The Midgans are an outcast and dispersed tribe of the Somalis, who are pagans, expert hunters, and artificers. They are despised by the others, but are tolerated because so useful.

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draught of air was produced in the same way as from bellows, and thus the iron was heated in the fire.

What most interested me was the expertness which they showed in applying the fine brass wire round the spear-heads and upper parts of the shafts. This is put on so as to assume different patterns in numberless variety, and to ornament them. It was done very expeditiously with the hands and feet, for the latter are used almost as much as the hands in order to hold and rotate the spear while the wire is being put on. The manner in which the ornamentation of the handles of the short Somali sword was produced was also not a little remarkable, for each mark upon them is made by separate pieces of the different metals and horn, being threaded upon a central iron rod attached to the blade and hammered tight; when all is finished and firmly fixed, they file the whole smooth. These ornamental handles are very much prized by the Somalis, and therefore have a very ready sale.

After a short delay in Berbera we started, as already remarked, on the afternoon of the 6th December. We started thus late in the day because we wanted to get our Somali men away from the town; for these people are like children, they have no idea of responsibility and the necessity of keeping their time and being ready; so by doing this we had them together in readiness for an early start on the morrow.

Our way at first led obliquely over the belt of stony, sandy desert which fringes the coast for some ten or twelve miles inland; our course was SW. Not a blade of grass or bush was to be seen while going over this, but when these ten or twelve miles were traversed, stunted mimosa and other thorny shrubs began to appear, and gradually became numerous; odd tufts of grass could be seen, antelopes bounded off out of the way and out of gunshot—the pretty little dik-dik (*Neotragus saltianus*) was one, the elegant speke's gazelle, and the madoqua (*Caphalophus abyssinicus*) were others—while ground-squirrels, jerboas, and hyraxes were caught sight of, and the birds were represented by the sand-coloured desert lark and odd vultures. The jackal, so hated by the Somalis, was also seen sneaking away under the bushes.

All this time the ground was rising, though imperceptibly, and before the second day was over we got into more rocky, stony country, the rocks being composed of handsome salmon-coloured and other granites, syenites, quartzites, and schists. Here the vegetation became more varied, more bushes and odd trees; all of thorny varieties of acacias, cacti with peculiar sooty ball-like flowers of cricket-ball size, varieties of aloes, and other kinds of plants gradually became more numerous; and with the vegetation more birds, such as wheatears, weaver-birds, and others. Dry beds of watercourses had to be crossed, and the ground alternated with rocks and loose, sharp-cornered gravel, as well as sand very frequently.

Every now and then we would meet native caravans with camels laden with the household utensils, and the huts of the men, women, and children who were on their way to the coast for the rice and dates which hold so large a place in their daily regimen. Cows, sheep, and goats were being driven along with them, and were to be disposed of for the

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purpose of obtaining the necessary money for the purchases they wished to effect.

On the way we camped at Hamas, a place at the base of some flat basalt-topped hills. In the morning early, one of our men was stung by a scorpion, a big one, which I prevented from again doing any injury by putting into a bottle for preservation.

During the day we passed a place called Addi Adeya. For Somaliland, this is a place for luxuriance of vegetation: trees of more variety, including palms, were scattered about the banks of dry river-beds, in the sand of which, by digging holes, water could be obtained, and there was much grass in patches under the bushes and trees. This, together

Laden pack-camels.

with the bushes themselves, gave pasture to the large flocks of sheep and goats which, with their attendants, and with some cattle and camels, were covering the ground. This place, having so much pasture, is often resorted to by these wandering people, and has suggested its name Addi Adeya, which means "White with flocks."

Here we had already arrived at the elevation of 2740 feet above sea-level, and the nights were comparatively cool. The evenings were remarkable because of the swarming moths which flew about the fires and lights incessantly; many of them were like our ghost-moths.

In the cool of the morning we generally walked, and one or two carried guns for the purpose of bagging a few of the numerous partridges,

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which are so clamorous at that time. Frankolin partridges, guinea-fowl, and an odd bustard would also occasionally be added to our larder.

During our daily marches, dik-diks and geranook antelopes (*Lithocranius walleri*), rock-squirrels, and rock-rabbits or hyraxes, warthogs, an odd hyæna, and desert-rat would be caught sight of; while birds became increasingly varied and numerous—parrots, toucans, rollers, sunbirds, beautifully coloured starlings, besides partridges, guinea-fowl, and bustards, together with Egyptian and other vultures, as well as an occasional golden eagle,—a pair of which we once saw nesting in a tree —these engaged our interest, and relieved the monotony of the march.

During the night, at our next camp, Jummat, we were startled by a rather awkward visitor in the shape of a leopard. He had suddenly leaped into the small zeriba in the middle of the camp, where the sheep were confined, and before the Sudanese soldier who was on the watch could get his rifle ready, had carried away a sheep out of the camp. A couple of hasty rifle-shots in the darkness, although apparently without having other effect upon him than to scare him, induced him to drop the sheep and take to flight without his prey. The sheep was, however, dead, for he had seized it by the throat. When making his exit from the camp he had got foul of the ropes of one of the tents, and had caused it to collapse upon the man inside, but otherwise no damage had been done.

The country continued rocky, the nature of the rocks remaining the same, except that a most extraordinary number of all sizes of veins of quartz and biotite, of beautiful shades of pink and green colour, intersected them in every direction. Dry sandy-bedded river and watercourses were frequent, while the banks of these occasionally showed luxuriant vegetation, but otherwise the general nature of the country was arid; nothing but the desert mimosa, with several species of aloes, dotted the gravelly or sandy ground. Occasionally a peculiar chalky conglomerate rock would show through the surface; and at one place, very much cut up by water, flint chips strewed the slopes. When we got as far as Gelele we caught sight of the Nasha Habalo hills: these are a landmark, for they can be seen for a great distance all round, and are near Hargaisa.

The country about here is very much sprinkled with the extraordinary obelisk-like white-ant or termite heaps. These take all sorts of fantastic forms, but here they always have a columnar shape which is quite different from that seen some three weeks later near the Hawash river in Abyssinia, yet in similar country. Why they should be so different in the two places is not easily accounted for, unless they are different species; but the reason they assume that shape here is because these termites attack the trunks of trees in order to devour the wood. They do this by enveloping the trunk of the tree in the clay mass to a considerable height; in the course of time the tree is killed and devoured, in fact disappears, but the columnar ant-heap remains. In the Hawash valley the heaps take more the shape of steep-sided mounds, of from three to five feet high. This shape appears to come about because the ants there attack a bush, which they gradually envelop with clay in a similar manner to that of the others; but in order to make short work of it they do not cover the

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short and narrow trunk and branches piece by piece, but take it as a whole. I saw bushes being covered up and disappearing in this way.

Hargaisa, a more populous part of the country, is a more or less level plain, which appears to have been a large lake in times gone by. This lake had been silted up in the course of time. It is entirely composed of alluvium, to what depth it would be difficult to say, but that it is considerable is easily seen in the sections which the torrential rains have cut through it, in the form of deep, steep-sided water-courses and river-beds. These are sometimes from thirty to even fifty feet in depth, and for the most part have perpendicularly precipitous sides. In some parts of the country near here, these are so numerous as to form a perfect net-work

Somali black-headed, fat-rumped sheep at Addi Adeya.

or maze, which, when once among, it is most difficult to get out of, for any one that does not know the country intimately.

There is a fair amount of game to be found generally at this place—gazelles and antelopes of all kinds, lions, leopards, elephants also; but when we were there most of them seemed to have left the country, and no sportsman was successful. Old tracks of elephants, but no other sign. Close to our camp there, several large tortoises were discovered: I measured the largest, and found it to be 29 inches over the back, 18 inches under the belly, and 40 inches in girth.

The place was alive with birds in great variety and remarkable beauty in the colours of their plumage: the lovely azure-blue roller; the gloriously iridescent metallic greens and blue-blacks of several varieties of starlings; the gorgeous greens of the parrots; the beautiful browns, goldens, and

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buffs of the sunbirds were specially noticeable; while the pretty long-tailed sparrows, the toucans, weaver-birds, shrikes, doves, some of which were smaller than thrushes, and numerous other birds always gave one something to gaze at, and to delight the eye.

Travellers have been so apt to describe the birds as beautiful, but as having fearful and discordant voices and cries; but my experience has not borne out this, for though the parrots and one or two other birds emit sounds that are the reverse of musical, yet by far the larger number have notes which are sweet or interesting, certainly not discordant and ear-splitting. Most remarkable in sound perhaps of all the birds is the bell-noted shrike or anvil bird. The sounds which this bird utters are extraordinarily like those of the blacksmith when striking his anvil at some distance: the notes are very full, searching, clear, and musical. Some of us got tired of these sounds after a time; but for my own part, I never heard them without being filled with wonder and interest, they are so clear and sonorous.

One often sees a bird or other animal vigorously scratching and digging in the soil to find food, make a burrow, or cover something over; but one day, while halting for lunch, we were impressed with seeing a very vigorous fly of no great size working most energetically in doing the same. It was evidently burying something—what it was we could not discover; but turning its back to a small hole which it had probably previously excavated, and by holding itself firmly with its four hinder legs, it very rapidly cast sand and loose soil with its two front legs, under its body between the hinder legs to the back of it, into the hole. The vigour it exhibited in this work was remarkable: every now and then it would turn round and examine how the work was progressing, and, not satisfied, would then resume it again. It did not cease until the depression was covered up level and quite obliterated. I tried to catch it for preservation, but its wariness and quickness was as remarkable as its performance, for in the end it disappeared down a large ants' hole, and with all my digging I could not reach it.

From Hargaisa we diverged from the main route and made our way to Jefr Auri and Jefr Medir, in the hope of finding game, for it was said to be plentiful about there. We went through Darbolek and Arabsyu, the latter place being crowded with flocks and herds, besides many people. On the journey there we saw a flock of tame ostriches, which were being farmed by one of the Midgans. He kept them from straying by means of hobbling them above the heel of their legs—that is at the lower part of the *thigh* of the bird, as it is generally called. Odd antelopes were seen, the oryx (*Oryx beisa*) among the number, and several fell to our rifles. After passing Arabsyu we went on *viâ* Jibuli. Here again was a great gathering of flocks and herds which had been driven a considerable distance for water, found at this place by digging holes in the sand of the river bed. The peculiar Somali fat-rumped, black-headed sheep; the small, white, nimble goat, and the humped Somali cattle were there in great force; and there was a great scramble and a lot of excited gesticulation when the separation of one owner's animals had to be effected from the others before departure.

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Soon after we passed this place, having heard that a lion paid nightly visits to a village near by in order to steal a sheep or goat, Mr. Blundell separated from us for the purpose of sitting up at the village and waiting for its next visit, which was expected that night. He took with him the devoted donkey as bait, but the next day he rejoined us at Jefr Auri, having been disappointed, for no lion put in an appearance.

After going to Jefr Medir (both Jefr Auri and Jefr Medir are hills which are rocky bosses of sandstone-schist and granite respectively, which protrude from the more or less level surface of the plain), we crossed the Meran prairie—sometimes called the Bund—to Jig-jigga. The prairie is an almost level stretch of treeless coarse grass-land 5374 feet above the

Our camp at Jefr Auri.

sea, and very different from the country we had come through since leaving Hargaisa. This had been less arid and stony: the ground was covered with a good deal of sandy soil and thorny acacias, cedars, and other trees, with aloes; many other plants and grass clothed the surface and formed a more or less continuous open "bush" or wood. Soon after leaving Jefr Medir this wooded condition came to a rather abrupt termination, and gave place to a stretch of thirty or forty miles of almost flat grass-land with only odd trees here and there at about the centre of it, near some knoll-like hills which rise from the level plain. Mirages, as might be expected, were very common here: lovely visions of lakes of water were spread out at no great distance from us, and looked very real. The grass

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at this time was dried up and shrivelled to a yellow colour, yet countless numbers of antelopes of all kinds could be seen feeding in company together all round between us and the horizon. Many fell to our rifles, though nearly all had to be long-range shots. Among them were Hartebeeste (*Bubalis swaynei*), oryx (*O. beisa*), and Aoul (*Gazella sœmmerringi*).

This stretch of flat plain appears to me to be simply a basalt plateau which has not been elevated in the same way as the hills around: masses of rock, almost certainly *in situ*, slightly protruded above the surface, but only rarely; nearly the whole was covered with soil, and the few loose stones to be seen were also basaltic.

I ascended one of the hills, some 400 feet higher than the plain, situated about half-way across. This I found to be also basaltic, but a peculiarity of the basalt was, that filling up many of the fissures in the rock there was a mortar-like calcareous substance containing pebbles, which resembled and was of the consistency of chalk.

One of the features peculiar to the prairie was the number of grasshoppers and locust-like insects which swarmed there. It was here that I first noticed the bird-like flight of these. Not only do they fly straight and swiftly, but they turn and dodge to one side so as to avoid one when they approach: this is done very swiftly, and they are exceedingly difficult to capture. Many of them have their under-wing coloured a rose colour, so that when they are spread out as in flight, this colour is very conspicuous and striking.

For several nights before our arrival at Jig-jigga the temperature after sundown had begun to become cool, and even cold, for we had arrived at a considerable altitude above sea-level, the height as shown by boiling-point being 5374 feet. The temperature in the day was, however, not excessive, averaging rather under than over 80·0°, while at night it sank under 44·0°. Our Somali servants therefore in the chill of the morning were rather pitiable objects, for until the sun's heat warmed them and the surrounding objects—as their clothing is nothing but thin cotton—they felt it acutely.

Jig-jigga, where we arrived on the evening of the 22nd of December, is the name of a place and station situated upon a small river which forms the boundary-line between British and Abyssinian territory. At this place its course is more or less south, near the base of the Mardo range of hills, which range forms a natural frontier and can only be crossed here by steep and rugged passes over it.

Our course until now had been roughly south-west, though we had diverged somewhat in the hope of coming across game, lion and elephant especially. Though antelopes had been plentiful, in this last we were unsuccessful, for no lion or elephant was either seen or heard, while all tracks seen were not of recent date.

At this point we had our first introduction to the Abyssinians, for here they had a military station in the form of a stockaded compound, in which were a number of toukuls or primitive circular huts, made of mud-plastered sticks and roofed with thatch, the roof being of the common conical form. These stockades are characteristically Abyssinian, being made of sticks of all lengths firmly fixed into the ground, and strongly

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interlaced to form a fairly compact wall. Some of the toukuls were the residences of the chief and head officials, while others were store-houses, for this is a station where customs are levied upon all merchandise coming into the country.

We were courteously received by the Abyssinian "Choom," or Chief, who called upon us in the usual state—that is, with a numerous retinue of men armed with rifles, who awaited his return. Presents, such as sheep, goats, fowls, eggs, milk, and tedge,[1] were sent us, and return gifts were given by us; while, hearing that we had a letter of, and permission

Somali boys.

to travel in the country from, King Menelik, no opposition was made to our progress.

Our journey to Fiambiro, a market-place and trading centre about two days' journey into Abyssinian territory, was through very different country from that which we had until now passed through. Brooks and streams intersected the land after we had crossed the rocky Mardo range, and watered it; hence villages and patches of cultivation dotted the landscape.

The houses forming the villages also indicated a condition of more

[1] Tedge is the native hydromel or mead, made of different proportions of fermented honey and water according to the strength required (1 to 7 being a common proportion), and flavoured with the leaves of a bushy herb called geysho (the "jershooa" of Sir Samuel Baker; see p. 347, *The Nile Tributaries of Abyssinia*, 1874 edition).

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settled and regular pursuits, for though they were still surrounded by stockades or zeribas, some of them were not; and the huts, instead of being mere temporary shelters, such as the Somalis use, were the permanent, conical-roofed, circular-shaped Abyssinian and Galla toukul. At this time also the harvest had been just gathered in, hence there were large heaps of ears of grain, dhurra, hadoti, and other kinds arranged outside many of the houses; while the recently cropped fields were yellow with the five to eight or more feet high stalks from which the ears of corn had been cut, and which were allowed to remain standing where they grew.

Our road, if such the unmade path or worn track can be called, led up rocky ascents and down extraordinarily steep descents, as well as over heavily undulating ground, much of it cultivated in terraces upon the hillsides, and reminding one of the vineyards of the Rhine and Mosel, until after a steep, very rocky ascent, up which the laden camels found it most difficult to climb, we reached the summit plateau upon which Fiambiro is situated. This is 6403 feet above sea-level.

The plateau is studded with small villages and habitations, while Fiambiro itself is simply a conglomeration of the temporary huts of the Somalis who come here to trade. Sheep, goats, cattle, donkeys, and camels, as well as grain, red pepper, and other food-stuffs, also cotton cloths of all kinds, are the principal wares exposed in the market, which at this time was being held every day. A more or less ruinous conical tomb of a holy sheyk is placed upon a conspicuous position here.

The geological formation of the country is very heterogeneous and diversified, for it is broken up in a chaotic manner. Basaltic layers interbedded with tuffs were to be seen in different places at all levels, but, where in any mass, generally in more or less parallel beds; underlying this in a few places a calcareous but unfossiliferous sandstone could be seen, and under this again granites, syenites, porphyries, and schists. These last are tilted at all angles, even almost vertically, and with a general tendency to dip to the NE.; they are intersected in all directions with dykes of quartz, biotite, and similar rock, and form the main mass and foundation of the whole. Needless to say, this diversity in level is caused through the breaks or faults which have broken up the surface, and these again have caused the magnificent scenery which is here presented to the view, but to which also are due most of the many difficulties with which the road of the traveller is beset.

At Fiambiro we spent Christmas Day, and it was occupied by paying off our Somali camel-drivers, who were to return to Berbera from here with the camels, for, the country being too hilly and mountainous for these animals, our baggage was transferred to the backs of mules, a number of which were awaiting us by arrangement by letter and messenger sent on before to Harrar, and with which our caravan was in the future to be made up. Needless to say, there was much excitement, gesticulation, and chatter while all this business was going on, and many the requests for baksheesh which were advanced by the departing camel-men.

Many of the baggage mules we used were Mr. Weld Blundell's property, having been bought by him on his former visit, and kept with

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others by Captain Harrington at Addis Abbaba, from whence they had been sent to meet us. In charge of these, and their attendant drivers, was an extraordinary figure, M'Kelvey, the Abyssinian Englishman. This man, though white, was attired in every respect just the same as an Abyssinian: his head was shaved, and, as so common with Abyssinians, bound up in a white cotton cloth; upon it was the usual terrai-like hat so frequently used by these people, the shamma or long cotton cloth worn as a shawl, or toga-fashion, over his shoulders, the short narrow-legged cotton pantaloons, and nothing upon the lower legs and feet. Under the shamma he also wore a cotton shirt, and that is all. This man was now one of the interpreters of the British Agency. He had been one of the

Humped Somali cattle.

original prisoners at Magdala, had been tortured like the rest, the scars of which he still retains; he had been rescued with the others, but after having returned as far as Alexandria, had elected to go back to Abyssinia and become an Abyssinian, and there he had remained ever since, thirty-seven years. When Mr. Harrington first found him he had almost forgotten his native language, but soon picked it up again when he once more heard it spoken by others.

All these years he had lived in the barbarous fashion of the natives; he had served King Theodore and King John as a soldier, but most of his time had been spent in making a living as a merchant, a kind of hawker who takes his wares upon pack-mules from place to place, attends the markets, and there disposes of his goods. He had thus travelled all over the country.

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Needless to say, his moral condition has sunk. Not only has he the vices of the Abyssinian, but combined with these are some European ones, and there are no redeeming qualities. He is most unreliable, a perfect yet plausible humbug and cheat. When at Addis Abbaba I visited his house. This is in not the slightest degree better than that of the natives—in fact, it is worse than many of them. There is no furniture whatever, no seats or bedstead; he, like most of them, squats upon the ground upon a goat's or cow's skin, and the bed is the ground, though slightly raised above the general surface. A more comfortless existence it would be difficult to imagine. He has many children by native wives, the last of which, nine months old, whose mother is a typical negress, was quite white and indistinguishable from the child of a European mother.

Through having travelled so much he was of considerable use to us as guide as well as interpreter, but after some experience with him, through his puerile quarrels with the native head-men we had to dispense with his services. He also had all the native fears, but exaggerated, with regard to going into an unknown country.

The Abyssinians, as is well known, are Christians, but their Christianity is more in name than in fact. They, however, take a real pride in calling themselves such; and indeed it is very remarkable that, surrounded as they are, and have been, for hundreds of years by Mohammedan and heathen neighbours, they have so stubbornly adhered to it.

Their religion practically is restricted to the keeping of feast and fast. Church attendance is practised only by very few, while the ministrations of the priests are costly, and, as the people say, can only be indulged in by the rich.

Very little trade, agriculture, or other art is carried on by them. The Abyssinian is a soldier, and he does little else. The women spin cotton, a few embroider in cotton and silk as well as do needle-work; their principal business is to make bread, cook, fetch water, and grind the corn. Their status is, however, better than that of the females of the neighbouring races.

From here the road passed through some of the most cultivated country seen during the whole of our journey, for especially as we neared Harrar, gardens well watered and irrigated, by water being led through rough wooden aqueducts and gutters which also surrounded the beds, were numerous and well stocked with cotton, red pepper, tobacco, coffee, and other vegetables, as well as bananas and other plantains and fruits.

The present town of Harrar is a walled Egyptian-built town, situated upon a rise in a beautiful wide undulating fertile valley. It consists of the usual mud-plastered, flat-roofed houses so affected by those people, arranged close together and intersected by steep, untidy, frequently terraced[1] narrow streets; a few churches, mosques, and principal buildings are to be seen, and it is the emporium of the principal trade of the country. Here are many Greeks, Indians, as well as some French, in the hands of whom most of the principal trade is carried on.

[1] That is, arranged in long shallow steps where the slope is at all great.

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The gates of the town are guarded by a motley array of soldiers, who lounge or squat around in the shed-like guard-rooms about the gates, their rifles and other arms being hung upon the pegs upon the walls above them. Their duty is to collect a tax or custom's impost upon all merchandise and produce which comes in.

Harrar is the seat of the Governor, Ras Makonnen, whose house is one of the principal buildings of the town, and there are many bazaars, shops, and markets in different quarters.

Most of the rock near by, and the stone of which the houses are built, is a fine red granite.

After some days' delay here, where, after receiving our supplies, which

Assemblage of flocks and herds at Gibuli, in bed of dry river.
Our caravan going down in foreground.

had been sent on before, hiring more pack-mules, receiving and answering letters, as well as collecting and making scientific investigations, on the 31st we proceeded on our way by the upper or mountainous route, *viâ* Kunnie, so as to avoid the hot desert, though shorter and more direct route.

The undulating fertile country we passed through to Lake Hanamaya we found still much cultivated. Cactus-bushes and creepers abounded, while specimens of the peculiar Quolquol tree (*Euphorbia candelabrum* or *Abyssinica*) were not infrequent. Some of these we saw in bloom, the beautiful rose-coloured bunches of flowers being upon the summits of the long, extraordinary, candelabra-like arms. Many of the fields and

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gardens were hedged round with branches of the tree planted in the ground; these grow like cacti, and form a very effective hedge.

For some days before as well as after this, we were charmed to see a goodly number of common British plants and flowers interspersed among the other, less familiar vegetation,—among them the dog-rose, jasmine, the wild clematis or travellers' joy, laburnum, mountain-ash or rowan-tree, dead nettles, scabious, and others were noted.

At Lake Hanamaya the birds were found to be so numerous and varied that it was determined to delay one day here in order to collect as many as possible, so we spent New Year's Day doing so. Warblers, grey wagtails, two varieties of coot, many ducks, teal, and pochard, geese, white and black ibis, stilts, sandpipers, knots, moor or water fowl, and grebes, swallows, martins, and finches, were some of those seen and collected. Some beetles and other insects were also found and preserved.

Here the rock was still red granite, among which blocks of a black and grey coloured sandy schist were erratically intermixed, as though pieces had been included in it when in a molten state. This granite had the usual veins and dykes of biotite intersecting it, and I here saw an excellent example of how deeply it becomes weathered and acted upon by the sub-aërial forces, for at one spot I came upon a perpendicular-sided gully or dry watercourse twenty or more feet deep, which a deluge of rain-water had washed out of the hill slope, the sides of which gully were so soft that they would crumble away upon touch. The coarser structure of the rock, with the veins and dykes, all showed perfectly, so that it was plain that it was *in situ*, and otherwise undisturbed.

We then continued our journey in a WSW. direction along the Arosso and Itu range of mountains, in part densely wooded and abounding in apes, as well as through often park-like scenery, to Lake Chercher.

Being here at a considerable altitude above the sea, between 7000 to 8000 feet, we were subjected to extraordinary variations of temperature, for it ranged from between 75° F. in the day to as low as 24° at night. Thus, in the morning before sunrise, hoar-frost would cover the ground, and the numbed and shivering natives in their light cotton apparel could do little until the sun rose and its heat revived and warmed them, while soon after it would become warm, and even hot.

Every day our path would lead us down precipitous descents, rough and covered with large and small loose stones, so precipitous that it was a matter of wonder as to how any animal, other than a goat or cat, could go down, much less a heavily laden mule; as well as very dusty, into deep, flat-bottomed valleys, many of which were plainly silted up lakes, again up steep ascents to often more or less flat-topped heights; yet, though the hills were frequently flat-topped, the outline and contour of these showed nothing characteristic of the basaltic formation, as is so marked a feature in other places where this rock is common, such as I have seen it in Skye, the west of Scotland, Franz Josef Land, as well as others show it to be in the Faroe Islands and other places. Here the hills had a rounded, flowing outline, which forcibly reminded me of the wearing down of old ice action. I looked to see if I could find any more marked evidence in the shape of grooved

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and scratched boulders and stones, but in this I was disappointed. I cannot but remark that the weathering action in these hot portions of the earth's surface appears to me, however, to be far greater than in the Polar regions, where the destruction caused by this agency is considered to be so marked. Here, therefore, this weathering action may possibly have destroyed these characteristic features.

The hills are almost entirely formed of basaltic material, but the layers of basalt, often thick, are interbedded with enormous masses of tuffs, agglomerates, and scoriaceous rock, the first of which is frequently of a dirty, yellowish-grey colour, and has a strong tendency to weather a deep red; this, with the weathering of the basalt, causes the soil everywhere to

Termite, or White Ant heap.

be of this red colour, and makes it a marked characteristic. Wherever the dip was observable, it appeared to be an easy one to the NW. (5 to 8°).

At Lake Chercher we again delayed a day because of the abundant bird-life found there—herons, geese, storks, ducks, grebes, and water-fowl of many kinds were obtained. Crickets and grasshoppers abounded in extraordinary number and variety.

From here we went on *viâ* Laga Hardim, where there is a very steep, rough, rocky ascent, at the foot of which is a telephone station, one of the many situated at every two days' journey upon the line which joins Harrar to Addis Abbaba. This line of wire, which is a single one, elevated upon posts or trees along our path, has been erected by a company,

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principally composed of Germans, and in which King Menelik has shares. It is very badly looked after, so that more often than not it is found to be broken down and no message can be got through. We had tried at several places on our road to speak with Addis Abbaba, but until we got here were unable to do so. The stations are within large, strongly stockaded compounds, containing a few toukuls which are little better than sheds. In this one, a common deal-wood, rickety table, a case as a chair, an electric battery, and a few sheep and cow-skins, formed the only furniture. Patience, very long-suffering, was needed before a message could at last be got through.

Many of the villages about our route are really permanent camps of armed men. These are always perched high up on the summit of the loftiest hills, and are quite a feature here.

After the long steep ascent we had a glorious view from the top, of miles over the Hawash river and plain, down to which a long, dusty, stony descent led. The dust and stones were due to the loose powdery tuff and scoriaceous rock of which the hills there are composed.

We made our way rapidly over the plain and river, and travelled here, for the most part, in the cool of the evening and till well into the night, as well as in the early morning, in order to avoid the great heat of this comparatively low ground. While camped close to the river, there were many alarms raised by the Abyssinians, who feared a raid from the Gallas and Danakils, who have a very bad name for this at this place—indeed with some reason, as a little to the north of where we were a caravan had been set upon three weeks before, when twelve men had been killed.

On one occasion great excitement was caused by men having been seen dodging about suspiciously among the bushes not far away, and this was augmented soon after by a large party of armed men being seen coming towards us some distance away, who were thought to be coming to attack us. Mr. Blundell led a party of our men, armed with rifles, which formed an ambuscade in a very advantageous position. The supposed hostile party, as it approached, was hailed, and ordered to halt and explain its business, when it was discovered that they were returning from an elephant-hunt in which they had been successful, so they were allowed to pass, and we were never molested either then or later.

After quickly traversing the Fantallé hills and the Kassim valley, we arrived at Godoburka. At this place we ascended the high rampart-like wall, and characteristically basaltic, which forms the edge of the south-eastern portion of the great Abyssinian plateau. This rampart-like wall has a very imposing appearance.

I may here observe that the great plain we had passed, through which the Hawash river runs, is studded to the southward with numerous, both small and large, beautifully preserved volcanic extinct craters. These are, without doubt, of quite recent formation, from a geological point of view. The Fantallé hills are composed of enormous masses of trachytic, andesitic lavas and tuffs, as well as obsidian and scoriaceous material of a different character from that of the basalt hills of the east, and of the rampart-like wall we had arrived at.

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From what I then saw, as well as subsequently, it is very evident that this lower-lying volcanic plain represents a much more recent volcanic phase of activity, which has taken effect along a line of weakness in the earth's crust running from the SW. to the NNE., and which begins as far south as Lake Rudolph or farther, and passes northward to the Red Sea and Aden, as far even as the Dead Sea in Palestine. At Lake Rudolph even now, I believe, there are active volcanoes still existing.

From Godoburka, ascending to Balchi, we reached the higher plateau, then traversed a more or less level stretch of country, thinly peopled and cultivated, and in three days arrived at Addis Abbaba, the present capital of Abyssinia.

This place can scarcely be called a town, for it consists of nothing more than a vast number of toukuls scattered singly or in groups over a stretch of undulating country some six miles in extent from north to south, and four to five from east to west. The surface is cut through and divided up by a number of deep, comparatively narrow rivers or brooks. No attempt is made to bridge these, therefore steep rocky descents and ascents have to be made in order to pass from one part of the town to another.

The King's compound or Gebbi occupies a prominent position in about the centre, upon a low hill which rises rather higher than the general surface. Within this large compound are many toukuls similar to those of his people, yet rather larger for the most part. One or two buildings are, however, a little more pretentious, especially those which have lately been erected by masons from India, with the help of one or two Frenchmen and Italians. Stone is quarried near by, and some are still in process of erection.

Britain has now its representative staying there in the person of Captain Harrington; the French are represented by M. Lagarde, the Russians by M. Vlasoff, and the Italians have also their representative. Indeed, the Russians have quite a large establishment, especially a medical one.

The foreign trade of the place is largely carried on by Indians, Greeks, French, and Armenians, who have bazaars there; but the main and more popular trade is almost entirely performed by means of the market—so also all over the country, for there are markets everywhere, which are attended by the travelling merchants, as well as the Galla agricultural producers.

The market at Addis Abbaba is necessarily a larger one than others that we saw, and a huge motley crowd congregates there on the market-days. The vendors squat on the ground with their wares spread out before them, with little or no order or plan, so that it is a matter of difficulty to pass from one part of the market to another, for one has to thread one's way carefully through the packed medley of buyers and sellers, ponies, mules, donkeys, cattle, sheep, and goats, as well as avoid the wares which are scattered about all over the ground.

There are from four to five of the usual circular, conically thatch-roofed churches in different parts of the town, surmounted by the never-failing, characteristic Abyssinian or Coptic cross.

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We were delayed there, for Mr. Weld Blundell and Lord Lovat, in order to obtain permission from the King to proceed farther, were obliged to travel to his camp, some 180 miles away, for he had left Addis Abbaba and gone north to near Magdala with his army, in order to receive the submission of his rebel subject Ras Mangasha.

I remained at Addis Abbaba in charge of the main camp, and to superintend the necessary preparations for the continuation of our journey. Part of the time, however, I utilised for the purpose of going forty miles south and visiting Mount Zouquala, the famous holy mountain of the Abyssinians. It is a lofty mass in the form of a truncated cone, which rears itself some 2000 feet above the level of the surrounding country, and forms one of the series of perfect extinct volcanic craters already mentioned.

Villages are scattered upon its lower slopes, the upper portion is densely wooded, and upon its summit is an oval rocky-banked, flat-bottomed valley a mile to a mile and a half broad and about 200 feet deep, which is partially filled up by a lake. The altitude, 10,000 feet or more above the sea, causes the climate, in the day even, to be here comparatively cold and bracing.

It is probably on account of the extraordinary, to the native mind, though natural conditions here, that a certain amount of superstitious value is attached to it by them. For by drinking the waters and bathing in the lake, miraculous cures are wrought, so that pilgrimages are made to it by the sick, maimed, and diseased from far and wide.

Some springs trickling from the rocky walls are also drunk by women and fervently believed in as a sure cure for sterility. The whole mountain-top and the miraculous waters are dedicated to the Virgin Mary.

It has also attracted to it a number of priests and hermits, who form a so-called monastery. These men live in isolated separate huts imbedded in the forest, a large number of which are hidden there—so also are churches. They are said to spend their lives in prayer and self-mortification. I saw some of them engaged in these rigorous religious exercises, which often take the form of severe floggings with hippopotamus-hide whips till much blood is drawn. Those I saw had all a wild, half-maniacal appearance. At this place I came across a church, in the compound surrounding which I was very much interested in finding a company of priests engaged in casting out devils and similar religious acts. A priest was standing in front of the sick person, facing him some twenty yards away; the patient stood with a dejected, downcast, and humble mien; the priest raised his arms high above his head, and threw his hands towards him, with other gesticulations, at the same time using declamatory and emphatic expressions. I fear I interrupted him, though I was stopped from going too near, for he soon finished, and the patient was moved away by his friends. How long this had lasted before my arrival I cannot say. There were many other sick persons I saw standing near, no doubt awaiting their turn to be operated upon.

I was admitted into this church, though my Mohammedan attendants were not, and was shown the usual motley array of gaudy chromo-lithographs seen in all the Abyssinian churches, which are attached all over

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the wall surrounding the inner square chamber, or "holy of holies." These represented the Virgin, Christ, and the Saints. Each had also descriptive letterpress attached in Latin, or in all or one of the four languages, English, French, German, and Italian, for they were of recent European origin, many of them having "Made in Germany" affixed upon them. The Russians having for some time had considerable influence in the country, the orthodoxy of any foreigner claiming to be a Christian is very much questioned, as the idea has gained considerable hold, through them, that no people are Christians except the Russians and they. I was therefore taken round and shown these pictures, and had to pass a sort of examination upon them. Needless to say, I came through with "flying colours," for had I been unable to make them out otherwise, the description upon each told me what they were. The priests, some ten or a dozen, were so delighted that, though they still somewhat doubted my orthodoxy, they took me to the door of the "holy of holies" and showed me one of their chief treasures, a double folding-panel on which were depicted the Annunciation of Mary, and St. George and the dragon. St. George is the patron saint of this church as well as of Abyssinia, I was told; so I pointed out—all this of course through an interpreter—that he was also the patron saint of England. This interested them considerably, though they still seemed doubtful; so the happy thought struck me that I had a sovereign in my pocket. This I quickly produced; it was rapidly and excitedly compared with their picture, the resemblance was immediately perceived, when their delight, wonder, and excitement was unbounded. I was indeed a Christian, and one of no mean order,—here was the proof, for I carried about with me a charm with the effigy of their patron saint, who was mine also, a talisman against all evil!

At Addis Abbaba, almost in the town, there are some hot springs which are very much used by the sick and diseased, especially those with rheumatism and skin eruptions. These bubble up through the mud and rock in a valley, and flow into a rivulet near by.

I took the temperature of them: that of the hottest I found to be 76·3 Cent., or 170° Fahr.

The people of both sexes strip themselves of all their clothing, and, without any regard for decency, sit in the small mud basins made by the water, selecting those where the water is less hot, in full public view.

Bathing is carried on in the same manner in the lake at the summit of Mount Zouquala.

Permission having been granted by the King, the reunited party proceeded on its way on the 2nd of March, and travelled almost due west, through hilly and varied country, for some distance along the base of the Metcha range of hills. We soon again crossed the Hawash river (which curves in a great semi-circle from here, where it is not far from its source, round to the south of Addis Abbaba, and then runs north), then the Guder and Gibbé rivers, passing through varied country, and arrived at Bilo in the Leka district. This is an important place 4768 feet above sea-level, and very populous, and here resides the "Choom" or Chief who administers the district.

The people of the place having heard that a Hakim Ingleesé (English

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doctor) was one of the party, a number of the sick and ailing of them practically besieged and mobbed my tent in order to obtain treatment. They came in such crowds, and were so eager to obtain medicine, that they pressed upon and almost overwhelmed my tent, so that in pure self-defence as well as to obtain breathing-space, for they would not listen to remonstrance or reason, I was compelled to get two of our Sudanese soldiers to lay about them with their hippopotamus-hide whips and so to clear a space in front of it—even then they would scarcely be kept back. Some of the priests did not disdain to join the number and swell the crowd of those who came for treatment. Needless to say, as many as possible were attended to. The examination of them, however, could be only cursory, while they (of both sexes) had to detail their symptoms, some of these being of a delicate nature, through an interpreter, before all the others who were within hearing and sight, for privacy was unobtainable. They, however, did this without any hesitation whatever.

Here also, before we departed, we had some difficulty with the Choom, who would not allow us to pass; for the King's letter, although mentioning that we were allowed to shoot elephants, did not mention that we might carry rifles, and here was the Choom's difficulty. It apparently never struck him that one could not shoot without rifles, or else he wanted to try to get a substantial present out of us—this is the conclusion we came to. We, however, would not be coerced into giving him anything, so after bluffing him a bit we passed on in spite of him, and proceeded to Gatamma.

Thence we passed over hilly country north to Lecampte in Sibu, when, after crossing the Didessa river and ascending the tremendously steep and rocky range of mountains on its western side, we passed on to Gimbi; thence we went in a NNW. direction over hilly and beautiful country through Najo to Mendi. All this portion of our route lay through the Galla country. The Gallas here have comparatively lately been subjugated by the Abyssinians. They are a fine-featured, well-formed agricultural and pastoral race, who are kept in abject subjection to their conquerors by means of their not allowing them to have fire-arms. The Abyssinians rob, ill-treat, and tax their produce without mercy, and they are evidently in a very unhappy state.

At Mendi we were kept prisoners for a time, for Dejadge Demis, to whom we were recommended and directed by the King, was away on a distant raid, and his deputy was either too stupid to understand, or else dared not use his discretion; so he obliged us to halt, until by our sending a letter post to the King, definite instructions could be sent to him. In three weeks our messenger returned, and all was arranged. Some delay was also caused on account of the difficulty of obtaining food, for the country had been twice raided by the Abyssinians, who had devastated and destroyed everything,—hence the dearth of supplies.

We then crossed the Dabus river and proceeded through the Berta or Shangalla country to Amdurahman's village, the Beni Shungul of the maps.

The Berta, or Shangalla people, as they are called by the Abyssinians,

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are quite a different race from those we had up till now been among. These are true negroes, while the Somalis, Abyssinians, and Gallas have almost European features and frames. They are the people who make use of the ugly, dangerous throwing-knives or swords, as well as boomerang-like throwing-sticks, also some very ugly barbed spears. They are also remarkable because of the amount of tattooing, in the form of gashes in the skin arranged in patterns, with which they cover their bodies, faces, and limbs. Their country had also been quite recently raided, burned, and devastated by the Abyssinians.

The Dom palm. West side of Dabus river.

From Amdurahman's village we made our way still north to Fasokl, where we crossed the Blue Nile in a ferry-boat to Famaka, the most advanced south-eastern outpost of the Anglo-Egyptian army. Here we were kindly received. Thence we proceeded still by caravan to Rosaires, then travelled down the river in the *Melik* gunboat to Sennaar, where Colonel Lewis, the hero of Dakla and other battles, received and entertained us.

The water in the river being still low, the gunboat could not go farther, so we were obliged to make use of the slow, clumsy, barge-like native boat or nuggar. In this boat we were cooped up for ten days in an eight-foot square, rough booth which kept the sun off us, and we arrived at Khartoum and Omdurman on the 1st of June. Here we were lodged in the Kaleefa's palace and entertained by Colonel Maxwell and the officers of the garrison.

After three days' stay, one of which we made use of for visiting the battlefield, we again took another nuggar, and after shooting the

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Shabluka rapids arrived at the Atbara, where we found two of the piers of the new bridge had already been erected. Thence by train and boat we were soon in Cairo.

Time will not allow me to enter into the details of much of the special work done by the expedition. Last night I was laying before the Royal Physical Society some of the results of the Anthropological and Ethnological observations and collections, and with the help of Dr. Catherine Raisin the Geological work will be published. In Zoology, vertebrates, consisting mostly of mammals and birds, have been handed over for description to the British Museum. Besides lions and elephants, there are about seventeen species of antelopes, as well as a number of rodents —"Some of which prove to be new"—and many very valuable scientifically.

But the birds, to which Lord Lovat continuously and untiringly devoted himself, are the feature of the collection. Altogether 523 specimens were taken, including 303 species, of which at least sixteen are new to science. Mr. W. R. Ogilvie Grant is giving an account of the birds in the *Ibis*. My invertebrate collection I have intrusted to my late comrade in Franz Josef Land, Mr. W. S. Bruce, who will attend to the proper recording of the species which are represented. It consists mainly of insects, which promise to be of very considerable interest. There are also a number of land Mollusca, as well as a few marine specimens from the Somali coast.

Mr. Robert Turnbull has kindly consented to describe the plants which I gathered and preserved during the journey, and at a subsequent date will publish the results of his investigations.

To Mr. R. T. Omond of the Scottish Meteorological Society I am specially indebted for having already worked up the meteorological observations I took during the journey. He has been so very good as to allow me to have it published as an appendix to the present paper in *this* Society's magazine,—it is therefore unnecessary for me to enter into details at the present moment.

TEMPERATURE OBSERVATIONS IN SOMALILAND AND ABYSSINIA.

By R. T. Omond, F.R.S.E.

These observations, made with a portable dry and wet bulb hygrometer by Dr. Koettlitz, while travelling through the countries named above, are necessarily imperfect in two ways: first, they could not be taken at regular hours owing to the exigencies of travel; and second, the exposure of the instrument was often unsatisfactory. But even with these drawbacks the data collected show many interesting features, and are

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valuable as being made in a region about which little is known meteorologically. Like most tropical climates, the conditions from day to day are so uniform that one or two observations give a fair idea of the climate for the season at which they are taken.

The readings begin at Berbera on the northern coast of Somaliland, and it is interesting to compare them with those taken a few miles inland in the desert. At Berbera on December 4th, 5th, and 6th, 1898, the temperature ranged from 75° after sunrise (6 to 7 A.M.) to a little over 80° in the afternoon, the highest observed being 84° at 3.15 P.M. on the 5th, and did not fall below 80° till after sunset. The humidity varied from 75 to 79 per cent. in the morning and evening to 72 or 73 in the afternoon, thus indicating little difference between day and night either in temperature or humidity, an effect doubtless due to the proximity of the sea and the presence of a NE. sea-breeze which blew from 10 A.M. to sunset almost every day.

Very different is the climate indicated by readings taken from 8 to 30 miles inland on the 6th, 7th, and 8th December. The temperature at night or in the early morning was from 63° to 70°, while from noon to 3 P.M. it ranged from 78° to 84°, the humidity at the former times being from 89 to 92 per cent., and at the latter from 62 to 72, thus indicating a climate of greater daily range of temperature, of greater instability of temperature from day to day, and of much larger changes in humidity than at Berbera. Not only is the desert humidity lower in the day, which might be expected, but it is also higher at night—so high as to approach saturation and frequently cause fog. This is a not uncommon feature of nearly rainless districts.

Farther inland, as the expedition passed through Somaliland and crossed the frontier into Abyssinia, the temperature fell as the height above sea-level increased. Thus at and near Fiambiro, 6400 feet, the temperatures and humidities were on December 25th, at 5.40 A.M., 52° and 86; at 11 A.M. 74° and 46; at 4.20 P.M. 68·5° and 52; and at 6.20 P.M. 60° and 59 per cent. By the ordinary rule at that height 24° would need to be added to each temperature to give the corresponding sea-level temperature.

The place at which the largest number of observations were taken was Addis Abbaba, about 8000 feet above the sea and situated on the southern slopes of the Andalan mountains. Observations were taken here from January 22nd, 1899, to February 6th, and from February 12th to March 2nd. The first period was practically rainless; during the second, thunderstorms and heavy showers were frequent. Readings were made several times a day at various hours from 6 A.M. to midnight. Distributing these readings according to the hours, and averaging each hour, we get a fair approximation to the diurnal temperature curve between 7 A.M. and 11 P.M. In the table below the mean values are given, first, for the 15 dry days, January 23 to February 6, and second, for the 17 days of wetter character, February 12 to March 2. Where the humidity is not given it indicates that there were less than four observations at that hour, and therefore

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its temperatures are not so good an approximation to the mean as the others.

	A.M.						P.M.										
Jan. 23 to Feb. 6.	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8	9	10	11
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Dry Bulb, . .	57·4	62·4	63·6	71·6	73·2	78·1	77·2	78·8	76·5	76·3	73·0	61·9	61·0	59·0	58·5	56·6	57·8
Wet Bulb, . .	49·3	51·2	51·3	55·1	54·8	56·7	57·0	56·9	57·0	55·7	54·2	48·0	49·5	48·5	46·5	45·5	46·7
Humidity, . .	75	67	64	56	..	48	50	47	51	..	52	60	..	..	65	67	..
Feb. 12 to March 2.																	
Dry Bulb, . .	57·2	59·4	69·0	69·6	66·0	75·1	82·5	72·9	76·7	63·8	62·5	58·3	..	56·2	54·9	54·8	51·8
Wet Bulb, . .	51·8	53·4	55·5	56·7	58·0	60·1	62·0	59·2	61·7	55·0	53·0	50·9	..	51·2	48·8	49·0	54·8
Humidity, . .	..	81	..	62	..	60	..	62	..	74	..	76	..	..	80	81	..

Taking those hours at which we have four or more observations this table shows, as might be expected, that Addis Abbaba has a rather higher temperature in dry weather than in wet, and that the humidity is very different in the two periods; during the wet it is higher, especially at night. Taking the two periods together, and averaging the temperatures at 9 A.M. and 9 P.M. and at 10 A.M. and 10 P.M., it would appear that the mean temperature of Addis Abbaba in February is about 62°, corresponding when reduced to sea-level to about 91° or 92°.

The only other place where the expedition stayed for any length of time was Mendi, near the western frontier of Abyssinia, and 5400 feet above sea-level. A halt was made there from March 31 to April 21, 1899. The thermometers were read regularly at 6 A.M., 6 and 9 P.M., and on more than half the days at noon, besides a few isolated observations at intermediate hours. The weather was much the same as during the second period at Addis Abbaba—showery and frequent thunderstorms. The average values for the twenty-one days dealt with were as follows:—

April 1 to 21, 1899.	6 A.M.	Noon.	6 P.M.	9 P.M.
	°	°	°	°
Dry Bulb, . .	59·8	83·7	72·8	66·4
Wet Bulb, . .	55·3	65·6	59·3	56·9
Humidity, . .	85	55	63	72

This shows a rather larger range both of temperature and humidity than at Addis Abbaba during the wet season. Up to the beginning of February the winds were mostly E. or NE.; but after the rainy weather began, calms and variable winds prevailed, which frequently blew in heavy squalls for a short time.

Another short halt was made at Famaka, 2100 feet, where the Blue Nile crosses the Abyssinian frontier. The weather was squally, with

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variable amounts of cloud, but fair. At this lower elevation the temperature was much higher than on the plateau of Mendi, and the range of humidity was great. From May 7th to 12th readings were taken every day at 6 A.M. and noon, and on four of the six days also at 6 and 10 P.M. The following are the mean values:—

May 7 to 12, 1899.	6 A.M.	Noon.	6 P.M.	10 P.M.
	°	°	°	°
Dry Bulb, . .	72·9	102·2	86·2	81·8
Wet Bulb, . .	67 3	71·3	67·9	66·6
Humidity, . .	83	37	55	60

The highest temperature observed during the expedition was here, viz. 106° at noon, May 8th; the wet bulb at the same time being 72°, giving a humidity of 34. This is, however, not the maximum, for if readings had been taken later in the afternoon doubtless a still higher value would have been obtained, with possibly an even lower humidity than 34.

GEOGRAPHICAL NOTES.

GENERAL.

The Temperature of the Free Atmosphere.—The science of Meteorology has recently extended its researches to those layers of the atmosphere which are at a certain distance from the surface of the earth, and are uninfluenced even by the highest peaks. These regions may fitly be called the "free atmosphere." Systematic study by means of balloons and kites has led to important results which correct earlier views in many respects. Professor H. Hergesell has written a comprehensive account of these investigations in so far as they throw light on the temperature of the upper air (*Petermann's Mitteilungen*, 1900, v.); and the following notes contain some of his conclusions. "The daily movement of the temperature of those layers which touch the earth's surface," he says, "is well known; I need only refer in this connection to such text-books as those of Sprung or van Bebber, in which all the phenomena, such as the general movement, the magnitude of the amplitudes, the times when the extremes set in, etc., are described with sufficient completeness. Various observations, especially those carried out in series by mountain observatories, have long proved that the conditions of the free atmosphere do not correspond with the changes which take place in the lower layers. The temperature-records from all summit stations have shown that increasing height is associated with a steady decrease of amplitude and with a change in the times when the extremes occur; and have seemed to indicate that in the free atmosphere, where all influence by the earth's surface is practically done away, the daily oscillation in temperature must be still shallower. Two elevated stations especially, that on the Eiffel Tower and that on Strasburg Cathedral, have shown very clearly how powerful is the influence of the ground on the layers of air which are nearest to it; and have proved that the daily movement of the temperature-wave, as demonstrated by ground observations, is

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really no more than a quite local phenomenon, which has practically nothing to do with the great mass of the whole atmosphere, and is entirely confined to the boundary layer of the solid and gaseous media. These observations are especially valuable because one may assume that they show the conditions of a nearly uninfluenced atmosphere, since the effect of the slender and skeleton towers must be inconsiderable. Let us look at the facts determined by the records of these tower-stations. The following table contains the daily movement at the ground station and the summit of the steeple at Strasburg, given in the form of a yearly average over three years; also the daily movement at the Paris stations in summer and winter."

DAILY MOVEMENT OF TEMPERATURE (1892-1894).

Year's Average.

	12	2	4	6	8	10	12	2	4	6	8	10
Strasburg (ground)	7·8	6·9	6·3	6·5	8	10·3	12·1	13	12·8	11·6	9·9	8·6
Strasburg (steeple)	9·1	8·3	7·6	7·1	7·4	8·9	10·4	11·5	11·8	11·4	10·7	9·9

Summer (July) 1890-1894.

Paris (ground)	14·5	13·9	13·1	14·3	17·4	19·9	21·2	21·7	21·2	20·1	17·6	15·9
Paris (Eiffel)	15·1	14·3	13·6	13·8	14·6	16·2	17·7	18·4	18·6	18	16·8	16·0

Winter (December).

Paris (ground)	1	·8	·6	·5	·4	1·8	3·3	3·9	3·1	2·2	1·7	1·2
Paris (Eiffel)	1·4	1·3	1	1	·8	1·2	1·8	2·2	2	1·8	1·7	1·6

These figures show plainly the decrease of amplitude of the daily movement with increasing height. In Strasburg, where the difference in elevation is 136 m., the amplitude at the upper stations amount only to 4·8, while that of the ground station reaches 7; so that at a height of 136 m. above the ground its range has decreased to nearly three-fifths. The curves derived from the Eiffel observations show that the decrease of amplitude with increasing height is greater in summer than in winter. Angot (*Annales du bureau central Météor. de France*, 1894, *Memoires*) gives the following table:—

ANNUAL MOVEMENT OF AMPLITUDE AT DIFFERENT ELEVATIONS.

	Ground	Eiffel Tower, 302 m.	Proportion
Jan.	3·6	1·3	·36
Feb.	5·6	2·3	·41
Mar.	7·9	3·9	·49
Apr.	10·2	5·1	·50
May	9·1	4·8	·53
June	9·4	5·2	·55
July	8·8	5·0	·57
Aug.	9·5	5·2	·55
Sept.	9·2	4·3	·47
Oct.	6·3	2·8	·44
Nov.	4·0	1·6	·38
Dec.	3·5	1·4	·40

The shifting of the time at which extremes of temperature occur must be noticed. The year's average from the Strasburg stations shows that the maximum occurs at the ground at 2.48 P.M., but at the summit of the steeple at 3.50 P.M.; the minimum occurring at these points at 4.50 A.M. and at 6.5 A.M. respectively.

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Both extremes, therefore, set in at a later hour as the height increases, and this conclusion is confirmed by the Paris observations. There is therefore a general law, that the daily temperature-wave is rapidly diminished at increasing heights; and that the hours at which the extreme temperatures occur become later in proportion to the elevation.

Sustained observations of the free atmosphere by means of balloons and kites have been undertaken only in recent years; they are as yet few in number and insufficient for the construction of averages with regard to the daily variation. Still, they are full enough to confirm the conclusions referred to above. The kite observations, for instance, which we owe to the zeal of Dr. Rotch, the Director of the Blue Hill Observatory at Boston (*Blue Hill Meteorological Observatory. Exploration of the Air by means of Kites*: Cambridge, 1897), are of high value in this respect. Of course the amplitudes of the daily temperature-waves at different heights cannot be ascertained by direct observations, since it is impossible to keep a kite at the same elevation above the ground for any length of time; yet, because a kite in its ascent will pass through the same elevation more than once, at different times, it is possible to draw conclusions from the records of temperature observations obtained within a definite time. Helm Clayton, who worked out the Blue Hill kite observations, arrived at the following estimates:—

Height in metres, .	0	49	180	500	1000
Amplitude, . .	11·6	9·9	9·3	2·4	·2 C.

These figures, obtained by direct observation in the free atmosphere, correspond approximately with those given by the tower stations mentioned above; they are, however, especially for the greater elevations, somewhat too small.

Professor Hergesell describes a direct attempt to determine the movement of the temperature-changes, by means of ocular observation, which he carried out on June 7 and 8, 1898. He kept a captive balloon for about 19½ hours at an average height of 700 metres, and read a thermometer every ten minutes during that time. The research (*Meteorol. Zeitschrift*, 1899, p. 49 ff.) included simultaneous observations on the ground and at the summit of the steeple. While the amplitude near the ground was 13 C., at 700 metres it was only a little over 3. The changes were especially small at night, during which time a nearly constant temperature obtained at a height of 800 metres.

It is very hard to study the daily change of temperature at greater heights than those already discussed, because balloons cannot be used for the purpose of direct observation. We have to return to the records of mountain stations, and study the determinations of atmospheric pressure. The temperatures given by such records are all more or less influenced by the surface of the mountain, and are therefore unserviceable for the estimation of the changes of temperature in the free atmosphere. But the observations of pressure, as Professor Hann was the first to show in a systematic manner, are capable of indicating the mean temperature of a column of air above a certain point. Hann has shown that we are in a position to draw conclusions with sufficient accuracy, from the difference of the daily barometric movement of two mountain stations, to the daily movement of the mean temperature of the layer of air which lies between them. From his calculations, published as "Beiträge zum täglichen Gange der meteorologischen Elemente in den höheren Luftschichten" (*SB. d. mathematisch-Naturwissenschaftlichen Klasse der K. Akad. der Wissenschaften in Wien*, 1895, p. 51), it is inferred that the amplitude at a mean elevation of 840 metres is about 1·7 C.; and at 3200 metres it is 1·2 C.

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Trabert (*Meteorol. Zeitschrift*, 1894, p. 440 ff.) has studied the temperature-wave at the highest layer—at the limit of the atmosphere—by an ingenious calculation from the proportion (about 13 per cent.) of the sun's rays falling upon the surface of the atmosphere, which are absorbed by the atmosphere itself, from which he estimates the amplitude at ·5 C., and places the minimum at 6 A.M., and the maximum at 6 P.M.

The study of the vertical distribution of temperature in the lower regions of the free atmosphere shows that the radiation from the earth's surface is directly answerable for the changes that are observed. In the case of the Eiffel Tower, where the higher station is 302 metres above the ground, the mean decrease of temperature at the higher point is ·84; while in the case of the Strasburg Cathedral steeple, 136 metres in height, almost the same annual mean obtains at the summit and at the ground, because the warming by night nearly compensates for the cooling by day. The day and night temperatures are as follows: Difference of temperature between height of 136 metres and ground at midnight + 1·3 C.; at midday − 1·7. Difference of temperature between height of 302 metres and ground at midnight + ·6; at midday − 3. The relative warming during the night is therefore less in the higher layers of the free atmosphere than it is in the middle layers, but the cooling of the atmosphere by day increases in proportion to the height. The reason for this fact is, that the nightly increase in temperature proportional to the height only reaches to a certain point, which point is lower than the summit of the Eiffel Tower, and above which the temperature again decreases; but the decrease of temperature by day reaches in general to the highest layers. This difference between the daily and nightly vertical distribution of temperature points to the cause of the whole process. The nightly warming and the daily cooling of the upper layers is nothing other than the effect of the earth's surface upon the layers which lie immediately above it. The ground, and the air next to it, are quickly cooled by night by intense radiation, while the upper layers, whose radiation is very slight, take hardly any part in this process of cooling. The latter therefore maintain a higher temperature, and we see, in consequence, a vertical increase in temperature. But by day this process is reversed. The earth is subjected to irradiation, and absorbs a great deal of heat, which also warms the adjacent air. The latter is therefore at a higher temperature than the atmosphere above it, so that there is established a vertical decrease in temperature which obtains, in general, from the ground up to the highest layers.

Professor Hergesell's paper is illustrated by maps and by diagrams, and some of his conclusions are such as cannot be discussed without graphic methods. His explanation of "May frosts" is specially interesting. Simultaneous exploration of the temperature of the atmosphere at great elevations at various points, on the 13th May 1897, showed that the cold wave was not a local change associated with the surface of the earth, but was due to a polar current reaching to the highest layers of the air.

AMERICA.

Geographical Exploration in South America in the Nineteenth Century.—Professor W. Sievers, in *Petermann's Mitteilungen*, 1900 VI., gives a very full and condensed account of this section of the history of geography. The article is illustrated by ten maps, showing the position of knowledge with regard to South America in 1799, 1810, 1820, 1830, 1850, 1860, 1870, 1880, 1890, and 1900. Reviewing the subject of his monograph, Professor Sievers remarks that the work of exploration during the present century has been very largely of private under-

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taking; that only the southern States, especially Argentina, began to take part in the investigation of their territories in 1875, and that there is therefore a striking disparity in the degrees of our knowledge of the several regions. While a large atlas of Argentina was published under the direction of Seelstrang as early as 1882, and geological and meteorological researches are directly encouraged in that country by the establishment of institutes and stations, the Cordillera States from Bolivia to Venezuela have hardly passed the stage of exploration by foreigners. In Brazil the government has as yet established no institutes for the scientific examination of its territories; this is left in the hands of a few individual States—Minas, Sao Paulo, and Para; the interior, with the exception of the great waterways, is practically unknown, and even the north-east States from Maranhao to Pernambuco have hardly been traversed by a few explorers. Guiana remains at the very earliest stage; the vast areas between the confluents of the Amazon are wholly unknown; and other regions, such as those of the sources of the Tapajoz and of the Madre de Dios, as well as the interior of the Chaco Boreal, still require the first investigation. In these regions, as in few parts of Africa, the work to be done is that of the pioneer. "The chief obstacle to the systematic scientific exploration of South America is the insecurity and the financial distress of the republican States, and it is not unlikely, on that account, that the most recently discovered parts of the African interior will be known in a scientific manner earlier than the larger part of South America."

ASIA.

The Trans-Baikal Railway.—On December 28th last the Trans-Baikal section of the Siberian Railway was completed, thus establishing direct steam communication between Europe and the Pacific coast. This section is 693 miles long, extending from the eastern shore of Lake Baikal, through Chita, to Stretensk on the river Shilka, a tributary of the Amur. The trains are carried over the lake on the ice-breaking steamer, designed and built by the Elswick firm. As an inducement to emigration eastward, the Russian Government has fixed the fares on the Siberian Railway at an extremely low figure; thus, the fare from Kieff to Khabarovsk is only 50s. On the 14th of last month the Trans-Baikal section was formally opened to public traffic, and has now passed into the charge of the State Railway Administration. The Odessa correspondent of the *Standard*, writing on the 15th, says:—"The department will now have the control of 4245 working versts of the great Siberian system, exclusive of the Ussuri line of 807 versts. On the further section of the latter—that is, from the station of Kaidolovo to Nagabana, in China—the construction is making rapid progress.

"From Nagabana the Chinese Eastern Railway is being pushed forward, through Chinese territory, to the boundary of the coastwise district, a distance of 1434 versts, with branches from the frontier to Grodekovo, on the Ussuri line; and from Charbin to Port Arthur and Dalni, a distance of 980 versts.

"Russia has now in her Asiatic provinces the control of 7309 versts (about 4874 miles) of working railways. She has also under construction 642 versts, viz. 324 versts in Siberia and 295 versts in Transcaspia, the latter being the new line from Merv to Kushk. In addition to these there are the 2429 versts of the Manchurian Railway, and the 47 versts of the Baikal circular line. For the time being, the constructive work on several sections of the Manchurian line has been suspended, in consequence of the Boxer Rebellion."

The Dahomey Railway.—The expedition charged with the preliminary survey for the Dahomey Railway has recently published its report. Its object was to

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study the course for a line of one metre gauge, for a distance of 150 kilometres from the coast, passing through those districts which promise best for future traffic. A further reconnaissance was made as far as the latitude of Carnotville, in order to determine approximately the cost of construction and the possible receipts of a second section of the line. The survey was carried out under great difficulties, the party often having to cut their way step by step through the forest. The work, begun at Kotonou in March of last year, was completed as far as Dan, 142 kilometres from the starting-point, at the end of July. M. Guyon, leader of the expedition, had meanwhile traversed the whole route to Carnotville and Tchaourou. The line will start from Kotonou, which is the only port at which the railway plant can be landed, and will follow the coast to Pahou, whence a branch will run to Ouidah. The main line will be laid to the province of Allada, of which it is expected to develop the palm oil industry; it will then skirt the north of Toffo le Lama, a vast depression 12 to 15 kilometres wide, which appears to be the bed of an ancient river. Leaving aside Abomey, which is only a military depôt established at the highest point of the kingdom, it will traverse the more fertile districts, Cana, Savakou, Passagou, and Dan; thence, running along a ridge with gentle gradients between the Zou and the Couffo, allowing of easy access to Atchéribé, it will cross the Zou, thus reaching the rich district of Paouignan and of the Dassas; and will then pass through Agouagou, cross the Ouémé to Tchaourou, and will be eventually extended, it is hoped, to Parakou and the Niger. The receipts expected are 3000 francs per kilometre as far as Tchaourou, at a charge of 40 centimes per ton per kilometre. The cost is estimated at 65,000 francs per kilometre. The length of the line, as far as the Niger, will be 700 kilometres. It is not yet known whether the work will be undertaken by the State or by a company.

Scientific Exploration of Tidikelt.—In the *Annales de Géographie*, 1900 V., M. G. B. M. Flamand, lecturer on the Physical Geography of the Sahara at the *École supérieure des Sciences d'Alger*, reports the observations made by an expedition which left Algiers for In Salah last November. The paper is accompanied by an excellent map, taken from the *Atlas des Colonies françaises* now being published by direction of the Colonial Minister, and edited by M. Paul Pelet (Armand Colin et Cie., Paris). M. Flamand's mission was to study the geological formations traversed for the purpose of the 1:800,000 map, to make hydrological investigations with a view to the creation of wells, and to map the chief caravan routes and the places at which the products of the interior are exchanged. The attack made by the inhabitants of Tidikelt on this expedition led to the capture of In Salah.

NEW BOOKS.

Facts and Fancies about Java. By AUGUSTA DE WIT. London: Luzac and Co., 1900. Pp. 259. *Price 7s. 6d. net.*

A very pleasantly written sketch of a visitor's impressions of the country and the people. The charms of tropical life and scenery, here so picturesquely described, cannot fail to attract the globe-wanderer to "that enchanted garden which men call Java."

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A Guide to Chamonix and the Range of Mont Blanc. By EDWARD WHYMPER.

A Guide to Zermatt and the Matterhorn. By EDWARD WHYMPER. London: John Murray. Fourth Annual Edition, 1900. *Price* 3*s. net each.*

Mr. Whymper's method of issuing annual editions of his Guides is a very commendable one. Mountain railways, hotels, and other conveniences for tourists are now developing so rapidly that an up-to-date guide is most desirable.

Murray's Handbook for Ireland. Fifth Edition. Revised and Edited by JOHN COOKE, M.A. With Maps and Plans. Pp. 516. *Price* 9*s.*

Murray's Handbook for Central Italy. Twelfth Edition. Rewritten by the Rev. HERBERT H. JEAFFRESON, M.A. With Maps and Plans. Pp. 313. *Price* 9*s.* London: John Murray, 1900.

Murray's Guides may at present be said to be undergoing a renaissance. They are not merely the old volumes revised, but they are really new books, although still in the same familiar red covers. Ireland, just issued, is one of the most creditable of the series. Within the past few years Ireland has developed greatly as a tourist resort, and the new handbook is quite equal to the occasion. The editor, Mr. Cooke of Trinity College, Dublin, has done his work thoroughly and well, and the new maps by Bartholomew are a most valuable improvement. Central Italy is also rewritten by Mr. Jeaffreson, who appears to have done his work most conscientiously, but in this case the majority of the maps are scarcely worthy of the book, or of Mr. Murray's improved new series. It is also a pity that Central Italy should not have been printed on the same thin paper as Ireland: weight and bulk are not desirable qualities in a guide-book.

The Rise of the Russian Empire. By HECTOR H. MUNRO. London: Grant Richards. Pp. viii + 334. *Price* 10*s.* 6*d.*

A work that is purely historical in character does not strictly call for extended review in the pages of this Magazine, but the present volume, dealing with a country whose area represents such a large proportion of the geographer's field of research, might be supposed to demand more or less attention from him. Unfortunately, we fear that this book will hardly attain the author's object of replacing the translation of "Rambaud's somewhat disjointed work," so far as it bears on the early history of the Russian people. In writing the story of a foreign country it is of course essential that the historian have some knowledge at first-hand of the best books by the men of that land. The list of "works consulted," preceding the table of contents, would suggest that Mr. Munro had fulfilled this condition. But on examination the list shows lack of discrimination: popular sketch and serious text-book jostle one another, while the most recent, and in some ways the most authoritative deliverance—that of Reumin—finds no place whatever. Throughout the text Soloviev and Karamzin are quoted side by side: it is as if one should write a history of Scotland, and interlard it with extracts from Mackenzie and Hume Brown.

Again, Mr. Munro is by no means happy in his transliteration of Russian words and names. "There is no satisfactory reason," he tells us in his preface, "why the two final letters of *boyarin* should be dropped, or why they should reappear tacked on to the equally Russian word *Kreml*." Still less, then, is there reason why Mr. Munro should employ a fanciful plural in the form *boyarins*, being either forgetful or ignorant of the fact that the word has its own peculiar plural. But the author is not true to his own standard, for we have Youriev

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(p. 47) and Uriev (102) and "knout" when we would expect "knut," while there is absolutely no reason for reproducing in Aleksandr and Petr the Russian forms of names that were originally Greek.

The writer has been thoroughly careful in his collection and collation of data, but we miss the dignified narration and balanced judgment that are commonly associated with first-class historical work. We select a couple of consecutive sentences at random. "This time Shouyskie took good care that his rival should not emerge from prison to trouble him, and the soul of Bielski put on immortality. A new Metropolitan, the second who had been nominated by the Shouyskies, was elected to fill the place of the shifty Ioasaf, who had leisure, in the seclusion of the Kirillov monastery at Bielozero, to reflect on the unwisdom of being all things to all men in sixteenth-century Moskva." We further read of Rome's ability to "send vast armies careering into the Holy Land on behoof of Jerusalem-bound pilgrims," of "packing off" metropolitans to distant cloisters, of record slaughters "which would have turned the early kings of Israel green with envy." Again, all the writer's references to the orthodox church show that he has not even taken the trouble to try and understand what simply becomes with him the butt of irrelevant flippancies. On the other hand, he succeeds in interesting his reader, and carries him on from first to last, even if it be by methods that are usually alien to this class of literature.

The Teaching of Geography in Switzerland and Northern Italy. Being the Report presented to the Court of the University of Wales on a visit to Switzerland and North Italy in 1898, as Gilchrist Travelling Student, by JOAN BERENICE REYNOLDS, B.A. London: C. J. Clay and Sons, 1899. Pp. xii + 112.

Scotland, like Switzerland, is a land of outstanding geographical interest. The methods of Swiss teachers have a special interest to Scottish teachers of geography. Miss Reynolds has given an admirable account of these in this little book. Rousseau, but above all Pestalozzi, and through him Karl Ritter and Guyot, have influenced the Swiss ideal, which is summed up in the title of Guyot's famous book, *Earth and Man*, and in the words of Ritter's preface to his *Comparative Geography*—"It is necessary to point out that this science has direct bearing on Man, for it is this point of view which gives to the study its importance and value."[1] This, as Miss Reynolds insists, is the true point of view of the teacher of geography in our schools. As a sense, as well as memory training, as a connecting-link in a crowded time-table, as well as a great humanising subject, geography demands an important place in the school curriculum.

As to methods, Miss Reynolds, with her experience as a teacher to guide her, reports much of great value to her fellow-teachers. "In those parts of Switzerland where education is most advanced, the text-book counts for little, the map for much, the teacher for more, and the pupil for most of all." The teacher too often forgets he has to teach the pupil as well as geography. He is an educator, not an expositor, and his aim should be to bring the pupil to sound conclusions largely through well-selected questions, which develop the pupil's interest and stimulate his self-activity. Geography is one of the subjects best suited to this method of teaching.

The chapter on "Methods of Teaching Geography in the Schools" contains an account of different systems, such as the regional survey and the imaginary journey,

[1] It is interesting to note the influence of Guyot on American geographers, some of whom are too commonly supposed to be geomorphologists only. The common definition of geography in America is the Earth in relation to Man. *Cf.* Preface, Davis's *Physical Geography.*

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adopted in Swiss schools, which, like our own nowadays, are not tied down by a rigid code, and can adopt diverse syllabuses and methods. Another chapter deals with the real journeys and excursions taken by many pupils in Swiss schools, and forms a useful supplement to Miss Dodds' account of school excursions in Germany, recently published by the English Board of Education. The sensible views on map-making are commended, especially to those who still give children political maps of Scotland to copy with all their county boundaries, etc.

"The schools of Switzerland . . . are remarkably rich in apparatus, and most of those which I visited had a museum of objects bought by the Government for use in teaching." Globes, reliefs, and large-scale maps are commonly used far more than with us, and some schools possess the complete collection of the twenty-five beautiful Dufour maps. How many Scottish schools possess even one of the equally beautiful old hill-shaded one-inch ordnance maps of their own district? Yet one of the most instructive as well as beautiful pictures that can be hung upon a school wall is half a dozen sheets of these Scottish maps, showing highland, lowland, and upland.

There is much to interest and stimulate teachers of geography in Miss Reynolds' book, and it is warmly recommended to all except those who are convinced that they have nothing more to learn about teaching or about geography.

The "Contour" Road-Book of England—Western Division, including Wales. By HARRY R. G. INGLIS. With 500 Maps and Plans. London and Edinburgh: Gall and Inglis. *India paper edition, 3s. 6d. net.*

As in the case of the previous volume—the "South-East Division"—the one under notice has been improved since the original volumes on "Scotland" and "England—North" appeared. In addition to the profiles, measurements, and general description of the roads, there are given small but handy plans of the principal towns, key-maps, and minute but clear illustrations of the various sights to be seen *en route*. Printed on India paper and handsomely bound, these contour road-guides contain a wonderful amount of useful information in their small compass.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Compiled from Official Sources. London: Charles Griffin and Co., Limited, 1900. Pp. viii + 292.

It speaks well for the general utility of this valuable reference-book that it has reached its seventeenth annual issue. It gives concise information concerning the officers, membership, etc., of the various societies, and lists of the papers published during 1899.

Illustrated Guide to the Vale of Yarrow. By JAMES M. MENZIES. Paisley and London: Alexander Gardner, 1900. Pp. 108.

The vale of Yarrow must always possess a romantic interest to the tourist. This little book, illustrated by twelve rather good views, will assist the stranger to reach and understand the hallowed spots immortalised in border ballads. It will also afford pleasurable reading to the non-visitor.

Viajes de Fray Francisco Menendez a Nahuelhuapi. Publicados i comentados por FRANCISCO FONCK. Valparaiso: Carlos F. Niemeyer, 1900. Pp. xix + 528.

We have to thank Dr. Fonck for presenting our library with a copy of this book. A word of praise is also due to him for editing and annotating this, a

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centenary, edition of the diaries of Menendez, who made extensive journeys, more than one hundred years ago, in the lake region of Nahuelhuapi. In a large map, which accompanies the volume, Menendez' routes are clearly and prominently shown, as are also those of later travellers.

Congrès National des Sociétés Françaises de Géographie, xix^e Session. Marseille, 1899. Pp. 538.

This meeting was held at Marseille in September 1898 under the presidency of M. le Prince Auguste d'Arenberg. The Geographical Society of Marseille has issued this volume containing the papers read before, and the work performed by, the Congress.

Atti del Terzo Congresso Geografico Italiano. Volume primo, pp. 319; volume secondo, pp. 671. Firenze, 1889.

These two volumes embody the work of the Third Italian Geographical Congress, which was held at Florence from the 12th to the 17th April 1898. Our delegate (Dr. J. P. Steele) to this meeting submitted a report of its proceedings, which was published in the *Magazine* (vol. xiv. p. 259).

Highways and Byways in Normandy. By PEARCY DEARMER, M.A. With Illustrations by JOSEPH PENNELL. London: Macmillan and Co., Limited. New York: The Macmillan Company, 1900. *Price* 6*s*.

This book has been written by one who is evidently an enthusiastic cyclist. It contains an account of a tour he made in a part of Normandy, where, by a judicious selection of byways as well as highways, he visited a number of places comparatively unknown, as well as many well known to the English public. The writer has a keen eye for the beauties of a landscape, and he can set them forth with considerable power. But his special gifts and taste lie in the appreciation and description of details of architecture, and as his route in this tour seems to have been exceptionally rich in ancient castles and churches, more or less in ruins, the writer has ample opportunity of exhibiting his knowledge and discernment of minute points of architecture which escape the notice of nineteen out of twenty observers. Hundreds of visitors gaze every year on the west front of the Cathedral of Rouen, but how many of them recognise it as "an epitome of all the Gothic styles"? "The north tower, built soon after 1160, marks the first development of Gothic architecture from the Romanesque; the other was finished as Gothic died in the sixteenth century. The aisle doors are twelfth century, the four square turrets are thirteenth, the tabernacle work is fourteenth, the rose-window is late fifteenth, the central porch was carved after the Renaissance had dawned in France, and the two pinnacle-shaped buttresses belong to the same period." Indeed, we have to confess that we were somewhat wearied by the plethora and minuteness of architectural description and criticism, and hailed with a sense of relief the legends and historical references with which the work is now and then lightened. Some, however, of the historical references are open to question. For example, the writer describes Herluin, the founder of the Abbey of Bec, the famous home of Lanfranc and Anselm, as "a soldier whose one ambition was to live humbly and forgotten and far from the unbridled life of his peers. Entirely simple, for all his experience of the world and natural gifts of practical wisdom, his only thought was to worship in peace." Who in this description would recognise Herluin, "the fierce and ignorant knight who toiled and prayed as a monk with the same vehemence with which he had fought as a warrior"? "Herluin, accustomed to head a band of savage freebooters, suddenly

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seized with a paroxysm of devotion, had become the head of a religious brotherhood, in which the no less savage austerity made a profound impression upon his countrymen, and obtained for it that fame for rigid discipline which led the Italian Lanfranc, as afterwards the Italian Anselm, to its walls." Again, in his description of Argentan, the writer says that "it was at Argentan that Henry II. heard of the murder of Becket, and lay for five weeks on ashes, seeing nobody." The real truth is that the king's first outburst of remorse and penitence lasted only three days. It is possible to place too much reliance on guide-books. The work has been profusely illustrated by the capable pencil of Mr. Joseph Pennell, and it contains many hints which will be of great service to any one who cares to follow the author's example and go for a cycling tour in Normandy.

NEW MAPS.

EUROPE.

ADMIRALTY CHARTS. River Forth, Carron River to Stirling. No. 114D. March 1900. Cromarty Firth, No. 3110. February 1900.

Admiralty Office.

The above are new charts, surveyed in 1898. The coast-line and topography are from the Ordnance Survey.

ENGLAND AND WALES. Bartholomew's contoured Cyclists' Touring Map. Scale 13 miles to an inch. *Price* 1*s.*

John Bartholomew and Co., Edinburgh.

This is the first general map of England with contours of altitude reduced from the Ordnance Survey.

NORTH LANCASHIRE. Bartholomew's Reduced Ordnance Survey. Scale two miles to an inch. Sheet 5. *Price* 1*s.*

John Bartholomew and Co., Edinburgh.

This is another new sheet of the English Series, and shows some improvements in contour colouring.

PARIS. W. and A. K. Johnston's Plans of Paris, 1900 Exhibition, and Map of France. *Price* 1*s.* *W. and A. K. Johnston, Edinburgh.*

BAVARIA. Aventins Karte von Bayern, 1523 A.D.

This is a reproduction, with explanatory text, of one of the earliest maps of Bavaria, constructed by the Bavarian historian Aventin. The original was discovered in the monastery at Tegernsee at the beginning of the nineteenth century, and deposited in the Royal Library at Munich. It is now reproduced and published by the Geographical Society of Bavaria.

ASIA.

CHINA. Atlas du Haut Yang-tse de I-tchang-fou à P'ing-chan Hien, par le R.P.S. Chevalier, S. J. Q. Fascicule de Hoang-cha tsi à P'ing-chan Hien.

Observatoire de Zi-ka-wei, Shanghai, 1900.

This is the completion of the Atlas noticed in our March *Magazine* of this year. This part consists of twenty-seven sheets. Considering the difficulties to be encountered in carrying out such a survey in a country more or less hostile to all surveys, the work reflects the greatest credit on the staff of the Jesuit Mission.

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BURMA AND ADJACENT COUNTRIES. Scale 1 : 2,027,520, or 32 miles to an inch. (Second edition. With additions and corrections to boundaries and railways up to December 1898.) Two sheets. *Survey of India.*

BENGAL, BIHAR, ORISSA, AND CHOTA NAGPUR. Scale 1 : 1,013,760, or 16 miles to an inch. (With hills, and with additions and corrections to railways and boundaries to December 1898.) Two sheets and printed index of places. *Survey of India.*

INDIA, RAILWAY MAP brought up to 31st March 1899. Scale 1 : 3,041,280, or 48 miles to an inch. 4 sheets. *Survey of India.*

INDIA. Scale 1 : 2,027,520, or 32 miles to an inch. 6 sheets uncoloured. (Third edition, 1898.) *Survey of India.*

INDIAN ATLAS. Scale 4 miles to an inch. Sheets No. 29 and 58, and quarter-sheets 1 and 2. *Survey of India.*

PERSIA. Scale 1 : 1,013,760, or 16 miles to an inch. 6 sheets, 1897. Compiled under direction of Sir T. H. Holdich, K.C.I.E., C.B., R.E. *Survey of India Office, Simla.*

This is the latest and most complete official map of Persia.

AFRICA.

ORANGE FREE STATE. W. and A. K. Johnston's War Map. Scale 12 miles to an inch. *Price* 6*d.* *W. and A. K. Johnston, Edinburgh.*

SOUTH AFRICA. Sketch Maps of the country round the following towns:—Pietermaritzburg, Winburg, Taungs, Vryburg, Harrismith, Philipstown, Bethulie, Boshof, Lichtenburg, Mafeking, Kroonstad, Ladybrand, Pretoria, Bloemfontein, Potchefstroom. All on scale of 1 : 250,000, or 3·94 miles to an inch. *Intelligence Division, War Office, No.* 1367.

Incomplete as they are, these are the best available maps for the districts they represent.

ATLASES.

ATLAS UNIVERSEL DE GÉOGRAPHIE construit d'après les sources originales et les documents plus récents. Avec un texte analytique. Ouvrage commencé par M. Vivier de Saint-Martin et continué par Fr. Schrader. No 32, Autriche-Hongrie. No. 42, Asie Physique. No. 35, Europe Centrale, Sud-Ouest. No. 53, Inde Méridionale. *Librairie Hachette et Cie., Paris,* 1900.

The first part of this great Atlas was issued about a quarter of a century ago, and yet is scarcely more than half completed! The high standard of work is still maintained—in fact, for the scale adopted, it is too elaborate and crowded. But when will it be finished?

L'ANNÉE CARTOGRAPHIQUE. Supplément annuel à toutes les Publications de Géographie et de Cartographie, dressé et rédigé sous la direction de F. Schrader. Neuvième Supplément, contenant les Modifications Géographiques et Politiques de l'Année, 1898. *Prix* 3 *Fr.* *Librairie Hachette et Cie., Paris,* 1900.

Although most of the information here published has already appeared in one or other of the Geographical Journals, yet it is most useful to have it here collected, edited, and published in uniform style as representing a year's changes in cartography.

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE SIAMESE MALAY STATES.

By NELSON ANNANDALE.

AT the beginning of last year I was permitted by Cambridge University to become a volunteer member on the Skeat Expedition, which was then on the point of starting for the Malay States of Lower Siam, in order to investigate the fauna, flora, and ethnology of the northern part of the Malay Peninsula. The expedition was a small one, consisting at first of Mr. W. W. Skeat of Perak, our leader and ethnologist; Mr. R. Evans, senior zoologist; and Mr. D. C. Gwynne Vaughan, botanist. My own position was that of junior zoologist, but in the course of my zoological work I found it of the very greatest advantage to associate freely with the natives, especially with the "pawangs" or magicians, who aided me on many occasions. Fortunately the Malay language is of such a nature that it is possible, without any special application or book-work, to acquire a sufficiency of the dialects spoken by the "orang rayat" or country-folk in a few months. It is not of the zoological results of the expedition that I intend to speak—they will appear elsewhere; but of my own impressions of the country and people of Lower Siam. First, however, it will be well to indicate the route we followed.

We commenced our work on March 29th at the Koh Sih Hah or Five Isles, in the Tale Sap, the great lake of Singgora. Thence we sailed to Lampam, the capital town of the state of Patalung, where we divided; Mr. Skeat and myself journeying inland on elephants for the space of a fortnight, and then returning to Lampam. From Lampam we visited the Tale Noi or Little Lake in the state of Ligor. We then went by boat to Singgora, on the passage which connects the Tale Sap with the sea. From Singgora we travelled in the Siamese chief commissioner's steam-yacht to Patani, and by land through the state of Nawnchik to the hill called Bukit Besar on the borders of Jalor. We spent a

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week on the mountain, and then proceeded by land to Biserat, the Siamese headquarters in Jalor. Here we spent six weeks. Mr. Vaughan and I went on from Biserat to Kota Bharu, whence I visited the village of Kekabu, on the Telubin river. We were then requested to return to Patani, and, after spending about a fortnight in the town, the whole expedition commenced a journey through Jalor, Rhaman, Legeh, and Kelantan, in search of Gunong Tahan, the highest mountain in the Malay Peninsula. The journey was broken at Kota Bharu, Tremangan, and Belimbing, but only for a few days at each place. After six weeks' travelling, we finally rested at Kuala Aring, in the Ulu Kelantan. Here our leader left Mr. Evans and myself (Mr. Vaughan had started for Bangkok from Belimbing), and went forward to look for the mountain alone. On his return, after six weeks' absence, I left the expedition; and, coming down the Kelantan river to another Kota Bharu in two days and a night, I caught a steamer for Singapore in the latter half of September. At Aring we were joined by Messrs. R. H. Yapp and F. F. Laidlaw, botanist and zoologist.

Throughout our travels we were assisted by the Siamese Government and the native rajas in a way for which I personally can never be sufficiently grateful. Not only was all our transport by land and river arranged for and provided free of charge, except for the gratuities which we voluntarily gave to elephant-mahouts and others; but at almost every town presents of food were sent us. Large bodies of men were put at our disposal, to run our messages, man our boats, carry our baggage round the rapids, and bring our letters from the coast. Houses were prepared, even in some cases built, for our reception at every halting-place; and we were accompanied by a body of officials, who from their very numbers sometimes impeded our progress.

The country between Ligor and Trengganu may be divided into three regions—the coast, the intermediate plain, and the hills. The coast-land is low and sandy, and, where it is not occupied by fishing villages and cocoanut palms, is often covered with groves of casuarinas, which recall the pine-woods of the north. The mangrove swamps that form so conspicuous a feature of the landscape in many parts of the Malay Peninsula are here entirely absent. No shelter is offered to vessels oppressed by storms upon this coast, for the mouths of all the rivers are obstructed by sand-bars and shallows that make it impossible to enter them when the sea is violent. For this reason navigation is to a great extent suspended during the winter months of November and December. The climate by the sea is remarkably healthy in the Siamese States; and some particularly sandy places, such as Jambu in Jering, are said never to have been visited by the epidemics of small-pox and cholera that occasionally decimate most Malayan towns and villages.

Among the hills which form the backbone of the Malay Peninsula, sending down spurs into the middle plain, the rainfall is very heavy. Almost every afternoon a violent thunderstorm rages for a longer or shorter period, and every morning a fog obscures the landscape; but at midday the heat is greater than it is near the sea, where cool breezes are more frequent. During the season of the rains, in winter, communication

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with the coast is said to be often prevented by floods. Dense jungle, matted with creepers and thorny rattans, covers the face of the country. Even high mountains cannot be seen because of the woods which surround them, and bury them in vegetation to their very summits. It is only along the banks of the rivers that the jungle is broken. Tiny villages, with their groves of cocoanut and areca palms, stand in little clearings along the main stream, with the woods at their backs; and up the tributaries clearings for hill-padi, maize, and bananas are formed by burning the jungle—out of the way of Malay nobles who may chance to travel in the interior.

It is strange how still and how silent nature seems as one journeys on the upper reaches of these rivers. On either side is a wall of dull, unchanging green, not rising directly from the water, but separated from it by a high bank or bare stretch of sand. The chattering of hornbills is heard from the jungle, and the movements of a troop of monkeys are occasionally seen among the foliage. Sometimes a little raft passes downstream, laden with durian fruit for the coast; more rarely, a man swims by with a long bamboo beneath one arm to support him. Now and then a snake glides along in the water, or a river turtle raises its snout from the surface. In still, deep pools by the bank fish are continually rising at the winged seeds which float down like the "keys" of the sycamore from a tree that grows by the water's edge. And then, towards evening, the nightly chorus commences. The "wa-wa" or gibbons howl like tortured children; cicadæ and cockchafers sing their harsh and grating song; frogs utter their various croaks; and the Malayan nightjar flits about over the river, giving vent to a note more like the whistle of a sandpiper than the jarring cry of its English relative. In the daytime hardly a bird, hardly a beast is seen; and the gloom of the jungle is only broken by the large white flowers of the water jambu—a tree that in the distance is not unlike a hawthorn—round which a host of gaudy butterflies are always fluttering. One soon comes to sympathise with the native belief that the jungle is only to be inhabited by evil spirits and tigers.

It is physically most unhealthy for Europeans to spend more than a few weeks at a time in this part of the country, and still more so for unacclimatised natives. The latter are extremely liable to malaria, and often fall sick immediately they leave their own district. Mosquitoes, however, and other noxious insects are far less plentiful in the interior of the Siamese States than in some other parts of the Peninsula; while, as for snakes, I had the very greatest difficulty in procuring specimens in the hill country. Nearer the coast they are certainly more common, but no venomous species is abundant upon land in any part of Lower Siam. In the sea off Patani, however, casualties from the bites of sea snakes are not rare among fishermen.

Between the mountains and the sea the plain is dotted with lower hills and small independent ranges. The level ground has been largely cleared for rice-swamps and orchards, and it is only on the hills that really thick jungle remains. One of the highest of these hills is Bukit Besar, on the borders of Nawnchik and Jalor, which rises to the height of over 3000 feet above sea level. Some of the lower ranges and isolated peaks,

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especially in Jalor, are entirely formed of limestone, and are riddled with caves, of which a few reach the length of over three-quarters of a mile. They lack, however, the magnificent stalactites that have rendered some caves in other parts of the world so famous for their beauty, though here and there in their inner recesses one comes across what looks like a stream of crystallised sugar falling from the roof. Only one of them can be compared in dignity of proportions to the Cathedral Cave near Kuala Lumpur, in the British protected state of Selangor. Several of the caves near Biserat were discovered by Mr. D. C. Gwynne Vaughan, who had great difficulty in inducing the natives to enter them; though at certain seasons of the year they are in the habit of collecting the bats' guano that covers

Wayside shops in Patalung.

the floor of the more remote caverns, in order to lay it upon the rice-fields, for which it is said to form an excellent manure. There is a local superstition that the wind which blows out from the mouth of the larger caves, caused by the funnel-shaped openings in the domes of some of the chambers, is the actual breath of the cave demon, who was described to me as being "all mouth and nothing else"; and that the bats are "devil-birds" (a name more generally applied to the owl), whose excrements falling upon the bare skin cause a loathsome disease. Our own men, however, soon became accustomed to the wind and the bats, and entered almost daily, in my company, or even alone, to collect the curious locusts, whip-spiders, and other animals which lived upon the walls. The largest and perhaps the most interesting of these caves is in a hill close to the village of Jalor.

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To reach it one must climb the hill, and then descend into its interior, which is completely hollow; thus entering a most magnificent natural amphitheatre surrounded with perpendicular cliffs at nearly all points. The mouth of the cave opens into this amphitheatre, which is probably caused by the dome of an immense cavern having collapsed. We utterly failed to persuade the men who showed us its entrance to come in with us. They said that the cave was guarded by four yellow cobras, who had become its kings and magicians. A very much smaller cave, in a hill near Biserat, has been utilised as a Buddhist temple, and a colossal recumbent statue has been erected in it, representing the Buddha sleeping beneath four seven-headed cobras. A still smaller grotto, in a neighbouring hill, is supposed to be the abode of the "Orang Parai," or Peri folk.

Another district in which caves are frequent is that bordering on the Tale Sap, in the northern part of the country. The Tale Sap, which is sometimes called the inland sea of Singgora, is, with the exception of the Tale Noi, the only lake in Lower Siam. Though the larger of these is nearly forty miles in length, and between ten and twenty miles broad, yet its depth in most places is not more than four feet; in some it is even shallower. At its southern extremity it communicates freely with the sea, but the water in its upper reaches, in April at any rate, is perfectly fresh, though the effect of the tides is felt in the river at Lampam. Of the many islands which are scattered over the face of the lake, the majority are flat and marshy; but the Koh Sih Hah, Pulau Lima, or Five Isles, which are the most northerly of the small archipelago, afford a type of scenery very rare in the Malay Peninsula. Precipitous cliffs of grey crystalline limestone, that in places may almost be called marble, sparsely dotted with arid euphorbias and screw-pines, and surmounted by dense and tangled jungle that resounds, morning and evening, with the voice of song-birds and insects, rise from the still water in which they are mirrored, riddled with caves from which the people collect the costly edible nests of the swifts that flit over the lake. At many times of the year the Tale Sap is said to be agitated by sudden and violent storms of wind and rain. Even during the days which we spent upon it, in real halcyon weather, innumerable minute rounded pellets of mud were suspended in the water, giving it a yellowish and unpleasant appearance. The bottom is composed of stiff blue clay peculiarly inimical to plant, and therefore to animal, life; and the fauna of the centre of the lake, that was collected by Mr. R. Evans, is confined to a few small worms, molluscs, and crustaceans which burrow in the mud, and differ little, except in point of size, from those captured in salt or rather brackish water near Singgora. A few insect larvæ were all that we took in a tow-net on the surface, and these had probably strayed from among the weeds at the mouth of the Patalung river. At Lampam, and round the shores of some of the islands, fish and prawns, are captured in considerable variety for food; and in the lake near the former place a kind of skate or ray is not uncommon, living in water which is fresh to the taste.

The bottom of the Tale Noi is largely covered with dead leaves and other vegetable refuse, and consequently its fauna is far richer than that

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of the Tale Sap; but even in the former animal life is by no means abundant. It was on the banks of the Tale Noi that we saw the only conspicuous floral display that diversified the general green monotony of the region through which we travelled. The edges of the lake, and more especially the narrow passage which connects it with the Tale Sap, were at the time we visited it bordered with great beds of white lotus blooms rising among their graceful leaves, and affording a magnificent foreground for the reeds and sedges in which the surrounding country was hidden. A solitary tree rose from the waste, dead and blackened and on it, as evening approached, gathered numerous long-legged wading birds to roost—storks and herons, and the beautiful little white egrets, that sit on the backs of the buffaloes in the swamps of Siam, just as starlings do upon the sheep at home.

Road between Patani and Nawnchik.

This passage between the two lakes is of considerable length, and so narrow that in many places two boats have difficulty in passing one another. It is, in fact, quite different from the broad water-way that is represented in its place upon the maps, even upon the large map of the Malay Peninsula, published in 1898 by Stanford of London, which is in many respects a most excellent piece of work. Though much of the information which it gives with regard to Lower Siam must have been derived from rather casual sources, its accuracy in delineating the southern states of this region is remarkable. Its information about Patalung and the neighbouring district is naturally not so reliable, for very few white men have visited these parts. Even at Lampam we were told that, excepting the Europeans who came with the king of Siam a few years since, only two white men were remembered in the town before our coming; and a heavy thunderstorm which occurred during our visit, at a time of year when no rain usually falls, was said to be

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the counterpart of a similar prodigy that had marked the stay of our countrymen. We visited several other villages where none of the inhabitants had ever seen a white man, and where our clothes, and especially our boots, caused the very greatest astonishment. Yet, though Patalung is the least explored of the Malay States—if, indeed, it can now be called one of them—travelling is perhaps more pleasant and more easy in Patalung than it is farther south. In the first place, the roads seem to be firmer—though this may be due in part to the fact that the only dry weather we experienced was enjoyed here—and certainly they go farther inland than they do in Patani or Kelantan. Then, not only has each Buddhist college a large rest-house for travellers in its immediate neighbourhood, but slighter shelters are also built by the priests, or under their orders, at shorter intervals than those which separate the temples. In the Lampam district, moreover, wayside markets are frequent, at which one can buy fried bananas, unfermented palm toddy, and rice-flour cakes—as well as other Siamese delicacies eqally obnoxious to Malay and English tastes, such as cicadæ and cockchafers fried in cocoanut oil, toad curry, beetle larvæ, red ants, and bee grubs. Roads similar in construction to those of Patalung are now being made farther south, under Siamese orders or requests given to the native rajas; but naturally Buddhist monasteries are not common in a Mohammedan country, and it is not the custom of Malays to set up wayside markets outside the immediate vicinity of their villages. In Kelantan, however, we were invited to take up our abode in a mosque, and lived there, no one objecting, for six weeks. At all the centres of Siamese influence that we visited—at Singgora, Patani, Biserat, Kota Bharu (Rhaman), and Tanjang Mas (the capital of Legeh), and even at Kota Bharu (Kelantan), roads were being formed in the following manner,—one which did not seem to ensure firmness in wet weather: a broad trench was first dug; the centre of this was filled up with bundles of sticks and other rubbish, and covered in with sand, leaving a ditch at each side to carry off excess of moisture. The centre portion formed the road. As neither Malays nor Siamese had any method by which they could keep to a straight line, the trench was dug in sections of about a hundred yards in length, and these were afterwards joined together. After all, the rivers which form a network over the country are still the highways of the Siamese States, in spite of the fact that their mouths are closed to craft of large size, and that their upper reaches are so obstructed by rapids that in many places navigation is only possible in dug-out canoes, or on rafts made by tying bamboos together in two layers. Even rafts, if heavy goods are carried, must be unloaded at many of the rapids, and the luggage carried round by porters for a short distance. It was in such places that the aid of the Siamese and Malay authorities became of the utmost importance to us; for, as often as we reached a rapid which it was impossible to "shoot" with our luggage on board, we found a large body of men, who had often come from a considerable distance, encamped upon the bank of the river under the headman of the district: the chief Siamese official with us, who is now, I believe, Commissioner of Patani, had sent a message bidding them

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assemble; and in some cases they had been awaiting our arrival for over a week. Even where there are no important rapids the rivers are so shallow that the only method of moving against the stream is that of poling—a most arduous and wearing method for the boatmen, though the grace and order with which they use their poles where the current is not strong gives their performance the air of an amusement or elaborate dance. When they struggle against the stream this illusion soon disappears; their groans and contortions, and, above all, their repeated cries of "Amok! Amok!" grow quite alarming to one only acquainted with the conventional English meaning of this word. The boats are narrow and flat. Where frequent snags and turnings of river are known to exist, a steersman sits at either end, with a large steering-oar in his hand; the polers walk up and down a platform in front of the house

Malay market-place, Patani.

that is built over the middle of the boat; and the kitchen, which consists of little more than a square box of sand, is placed behind. The craft used on the Tale Sap are of very much the same character, except that they are propelled by paddles; those of them which are not house-boats are provided, like sea-going craft, with a sail. Where there are no roads, and where the rivers degenerate into mere jungle burns, it is necessary to travel on elephants, which can make their way through swamps that the leeches render extremely unpleasant for foot-passengers; and along the beds of narrow streams too deep for a man to ford, but too tortuous or obstructed to navigate. Occasionally also one travels day after day through alternate rice-fields and jungle paths: the nature of the latter is shown by the following incident. When we were journeying through Legeh it was discovered that our escort were conducting us by a route other than that we had intended to take, and, on making inquiry, we were told that some trees had been blown down across the track

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which led through the district we had meant to traverse—three years before; and that no one had been there since to see what condition the path was in. The rajas of Jalor, Rhaman, and Legeh were induced by the representations of the Siamese, and of our chief, to lend us no less than forty elephants, for the transport of our escort and our four selves. Each elephant was accompanied by its "gambala" or mahout, who was very often the only person who could approach it. When an elephant attacks its own gambala it is considered to be mad, and the only cure for its insanity is supposed to be stabbing its trunk with a spear or kris. This is said to allow the oil, which causes madness, to descend from its brain. Several of our beasts bore scars arising from this treatment; in one case the trunk was perforated to the central channel. The Siamese elephants are not so highly trained as those of India, though many of them are born in captivity—a thing that is said to happen very rarely in the latter country. The reason why it becomes possible in Malaya is probably that the elephants there enjoy a very large measure of liberty, being allowed when not working to wander in the jungle, only restrained by hobbles, shaped like a figure of eight, which are slipped over their fore-legs. The gambala may be described as forming a secret society, as both they and their charges must be initiated by secret ceremonies before either man or beast is allowed to perform his duties. It is a common belief in the Siamese States that all elephant men smoke opium, even when they first enter the profession as little boys of nine or ten; and certainly I never talked to one who denied the accusation. They are curious people, these elephant mahouts, mingling little with their fellow-men, and speaking to their beasts in a language which they believe to be the real elephant speech, and which the elephants perfectly comprehend—when it is accompanied by the necessary pressure of the knees upon their neck, or at any rate by the motions of a little rattan cane with which each gambala is provided.

There are no beasts of burden in Lower Siam but elephants, though buffaloes are used in ploughing the rice-fields. The rajas often have their ponies, and in Patani Japanese "rickshaws" ply for hire in the streets of the town, drawn by Chinese coolies; but both ponies and rickshaws are part of the external conditions that are being impressed upon Malay and Siamese towns, as upon towns all over the world.

Of the towns in the Siamese Malay States it is hard to give an idea within the compass of a few words, so intimate is their mixture of native barbarity and imported civilisation—European civilisation that has reached them by way of China or Siam. The most salient feature of the Siamese towns is perhaps this foreign gloss. Lampam, for instance, which is built almost entirely of palm leaves, rattan basket-work, and planks smoothed with the rude adze that is the most important tool both of Siamese and Malays, has a well-ordered street lighted at night by oil-lamps; it has a police office, and a force of native police under a Sikh corporal—all dressed in khaki uniforms; above all it has a post-office with "Stamps Sold Here" written over the door in English, a language of which it is exceedingly improbable that a single person in the state of Patalung can read a word. Not half a dozen

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white men have seen this notice, which is translated into Chinese and Siamese for the benefit of natives. At Biserat, where a similar placard is hung up outside the post-office, the post-master is a Chinaman who cannot read any language but his own; he had not so much as heard tell of the country of England, but inquired of one of our servants who took some letters to post, whether it was in Europe or London. Singgora, which is a larger and more important town than Lampam, has even greater pretensions to being civilised; but it is said to be in the power of Chinese secret societies, such as those which at one time all

Framework of a Malay house, Kelantan

but ruined the peace of Singapore. Singgora is the favourite, though not the official, residence of Phya Sukum, the Chow Kun, or chief commissioner, of the Ligor Circle, a gentleman to whose liberal policy and honest statesmanship it would be almost an insult to apply the one-sided epithet enlightened. At present the architecture of the public buildings is Chinese, and the town is encompassed by a battlemented wall, also of Chinese design; but Phya Sukum is now building himself an official habitation outside the town, which is hot and unhealthy, and intends shortly to pull down that part of the wall which fronts the sea;

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to construct in its place a new market, and with its materials to build a breakwater behind which fishing-boats may take shelter in stormy weather. Having regard to the damage which may be done by fire in a town of thatched houses, he has made a rule that the roofs of all new buildings erected in Singgora must be covered with tiles.

In going down the coast from Singgora to Patani—a distance of about 30 miles—one steps, as it were, out of Siam into Malaya; language and costume change, everything that is Malay becomes conspicuous and predominant. Patani has a Siamese quarter, it is true, but the chief activity of the town is centred in the Malay market near the Malay raja's palace. The houses are raised higher above the ground than is usual farther north. There is less pretension, and probably more comfort. In Kota Bharu (Kelantan), however, which totally lacks the clean and tidy look of Lampam or Singgora, direct and frequent intercourse with Singapore has produced a surface gloss of civilisation, typified by the many clocks which are heard striking in the houses; though Kota Bharu is a very much more barbarous place than Patani in reality, and its streets far more malodorous than those of any other Malay town that I visited. The Malay custom of raising the houses above the ground on posts —a custom which is also followed, though less universally, by the Siamese—has here caused a most insanitary state of affairs. In the country, in Patani, and in the other towns of the Patani States, filth is not allowed to accumulate in the space beneath the dwellings; but in Kota Bharu no such precaution is taken. The result can be easily imagined. I was informed that, though fifty or sixty persons were dying daily from smallpox at the time I visited the capital of Kelantan, the epidemic was entirely confined to the Malay quarter, and that neither Chinamen nor Siamese—whose houses are there built upon the ground—were attacked. A glance at the map will show that all the towns which I have just mentioned are situated near, but not upon, the coast. The reason for this is probably that in the old piratical days the founders wished to be near the sea, but were afraid to build outside the bars that protected the rivers against freebooters and other enemies. Now that such fears have become things of the past, thanks to the existence of a sovereign government, people do not like to change their place of abode, even though by so doing they might perhaps increase their trade and revenue. Of the towns, or rather larger villages, situated in the interior I need not say anything; until they were influenced by Siam they were merely the seats of the rajas' courts, and even now their only importance is based upon the fact that they are centres of administration.

No less than five distinct races of men inhabit the country of which I have attempted in the first part of my lecture to give a rapid sketch—the Malay, the Siamese, the Chinese, the Sakai, and the Pram. Of the Sakais generally, scattered tribes of whom extend as far south as Johor, very little is known. Those of Patalung were so timid that we utterly failed to see them, though, by the exercise of great diplomacy, we managed to reach a small cave from which they had just fled a few hours previously, leaving behind them their

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beds of freshly plucked leaves, a dead fire, the remains of a tortoise which they had been eating, and a small piece of cloth which showed that they must have had some trade or system of exchange with the more civilised people of the country. The Sakais are little black men, with thick lips and more or less curly hair; their civilisation is of the lowest type, superior only to that of the Australian natives; they have no weapons but blow-guns—long straight tubes of bamboo through which they propel with their breath splinters of wood sharpened to form

Sakai slave boy (aged about 15), Kelantan.

darts and poisoned with the juice of the upas tree and other poisons. Except where they come in contact with other races, they wear no clothes beyond a narrow strip of bark cloth. They have been persecuted and hunted by Malays and Siamese, who look upon them rather as beasts than as men, until they have retired deep into the jungle; but they are the aborigines of the country.

The Prams (*i.e.* Brahmins) are very far removed from the Sakais, but even less appears to be known concerning their customs and origin. They are a people of Indian descent who live among the Siamese of certain

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districts of Patalung and Ligor—where they are said to have a temple of their own—not inhabiting separate villages, but preserving the purity of their race. Their language is Siamese, and, except in the case of their chiefs the White Prams, they can only be distinguished from the Siamese of Patalung by the fact that they wear the hair long, coiled up at the back of the head, and by their pronounced noses and generally Aryan type of features. The Prams are considered a particularly sacred people; their chiefs refuse to bow down before the king of Siam himself, when they are wearing the white robes and peculiar turbans which distinguish them at once from the other races among which they live. Like all Buddhists, however, the White Prams do reverence before the priests of the yellow robe. The Prams assert that their ancestor came from India several thousand years ago, bringing with him the dung of a cow which had swallowed a portion of the ashes of the Buddha; and, after being shipwrecked on the west coast of the Malay Peninsula, made his way to Ayuthia, the ancient capital of Siam, which is situated on the Menam river some distance north of Bangkok. They claim, as a special privilege derived direct from the "Lord of Heaven," the right of burying their dead in a kneeling position. Mr. Skeat was so fortunate as to obtain copies of their sacred books of ritual and history from the White Prams, who are priests as well as chiefs. The history was written in old-fashioned Siamese, the ritual in some Indian dialect other than Pali, expressed in Siamese characters: their translation should prove of great interest. The White Prams were able to read them, but could only give a very general summary of their meaning.

Wherever the Chinaman may wander, and however long he may abide in a foreign country, it is impossible to regard him beyond the bounds of his own celestial land as anything but a settler. Even in Siam, where he is thoroughly at home, he does not seem to be part of the scheme of the country, but rather to exist as a necessary excrescence upon the outside of things. He does not bring a wife with him from over the sea, and—though the custom is not so universal as in some other regions—he often sends back his bones to China. For all this, the Siamese and the Chinese, races are so near akin, whatever may be the exact origin of the former, that they amalgamate most regularly and easily. The Chinaman is always ready to adopt the State religion of the country in which he sojourns, in addition to his own. Siamese art, such as it is, is almost wholly derived from China. The habit of eating pork is not a bar between Chinamen and the Siamese; and it is interesting to notice that, whereas the son of a Chinese father and a Malay mother often grows a pigtail and calls himself a Chinaman, his maternal relations scorning to recognise the son of a pig-eater as their kin; the son of a Chinese father and a Siamese mother just as often calls himself a Siamese, and attempts to lose sight of his paternal ancestry; for, though Cambodian blood is in Bangkok what Norman blood is to an Englishman, the Chinese race appears to be considered an inferior one among all nations with which it has come in contact. The Chinaman, however, is the only member of the five races of Lower Siam that shows any aptitude for trade; he has made himself indispensable throughout the Malay

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Peninsula. Local traffic in fruit, fish, and rice, in charms and amulets, and even in foreign articles of attire, is often in the hands of Malays; on the upper reaches of the Kelantan river there exists a regular floating market, entirely managed by Malays, where jungle produce is bought, and coast and foreign luxuries, such as swamp-rice and European cloth, are sold. The Siamese male is slothful as a rule, though he does not adorn his sloth with the graceful dignity of the Malay; but the Siamese woman is a capable person, and, being granted a liberty refused to the most emancipated of Mohammedan females, she very often opens a shop on her own account, leaving her husband at home to look after the babies. The Siamese woman, however, has neither the capital nor the cunning with which to compete with the Chinese, bound together as they are by their secret societies. Not only does this alien race outbid

Young Malay of Rhaman.

all competitors in the auctions by which the government monopolies are granted—such monopolies as the right to collect edible birds' nests, to keep gambling-dens, to sell opium, and, in the Siamese towns, retail *samsu* or rice-spirit—but it is Chinese merchants who regulate all the import and export trade of the country, who alone exploit its mineral wealth, and alone practise any form of agriculture on a scale larger than that to which his stomach forces even the Malay villager. It is thanks to Chinamen that it is now possible to buy Manchester cottons, German prints, Japanese lucifer matches, Javanese printed handkerchiefs, Chinese porcelain, and American or Sumatran paraffin oil, in even the smallest markets—markets which hardly a white man has ever seen. The exports of Lower Siam are less important by far than the imports, but they too pass through Chinese hands—dried fish from Singgora; salt from Patani; tin-ore, a little jungle produce (chiefly damar and beeswax) and a little

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gold; silks, copra, and poultry from Kelantan. The difficulties of communication and transport, the dread with which the natives regard the jungle—these, combined with other causes, restrict all trade. Nevertheless, the Chinaman, waxing rich on the proceeds of his industry, in spite of all its limitations, not unfrequently rises to high position in the State. The present governor of the town of Singgora is a Chinaman; the Siamese commissioner of Patani is a Chinaman's son. At the gold-mine of Tomoh, in the interior of Legeh, a Chinaman has actually been allowed to assume the title of raja, and to wield absolute power over the Malays and Siamese of the district. He is said to have commenced business at Tomoh on quite a small scale, possibly as farmer of the opium monopoly; but became possessed of the gold-mines, which appear to be fairly rich, and consequently of the rajaship, by means of his business talents. As one of his Malay subjects remarked to me, "he has given much money to great Siamese men." It was satisfactory to hear that he had been persuaded to cease from killing his subjects by an English mining company which had their headquarters at Belimbing—the nearest Malay village of any size to Tomoh—for several years, but were forced to leave the country by fever, and I know not what other causes, leaving their steam-engine alone in the jungle. This we were told by some Malays who invited us in to circumcision feast at Belimbing; but when our chief appeared upon the scene shortly afterwards, riding on the same elephant as the Chinese raja himself, several of the guests fled into the woods, in fear that we would repeat what they had told us. It would be injudicious to trust what they said implicitly, but their accusation and dread of the raja had probably some foundation.

Before I speak of the Siamese properly so called, allow me to say a word or two upon the cave-dwellers of the Koh Sih Hah, Pulau Lima, or Five Isles of the Tale Sap, as the very existence of these people has been denied on high authority. With great injustice, and with quite unnecessary acrimony, Mr. Warrington Smyth, whose books are standard works on Siam proper, ridicules the statements of former writers who have called these people troglodytes and cave-dwellers. In especial he is roused to pour forth his scorn on the following passage in Dr. Keane's *Eastern Geography*, that these troglodytes "are born, live, and die in the caves with which the archipelago everywhere abounds, occupied exclusively in collecting and preparing for the Chinese market the edible swallows' nests covering the walls of their rocky dwellings." The statement is inaccurate, in so far that the caves in which the people habitually live are not the same as those from which the nests are gathered; but this does not justify Mr. Warrington Smyth's violent diatribe against travellers who tell stories on insufficient evidence. His own reasons for disbelieving that the nest-collectors live in caves are not exactly scientific; they are (1), that there are lake-dwellers also in the Tale Sap (that is to say, persons whose houses are built on stakes driven into the water instead of into the ground), and that it would be too idyllic a state of affairs for lake-dwellers and troglodytes to inhabit the same district; and (2), that he has been told that the caves are haunted by evil spirits. We stayed for two nights off the chief village upon the

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islands, and certainly the majority of the villagers were troglodytes; but a few lived outside the cave in which the rest had their abode, in houses built under an overhanging rock. The cave was of no great extent, and frequent openings in its roof gave access to light. The inhabitants had built low platforms of split bamboos tied together with rattans, to serve as family residences, and some of these which were situated in places exposed to dripping moisture were protected therefrom by thatch roofs made of pandanus leaves. The bachelors' quarters were in little natural recesses. At the mouth of the cave tiles had been laid down in a pavement under a shelf of rock in front of two curious little shrines, in one of which stood a figure said to represent the spirit of the bird-caves, while in the other conical stones were the objects of reverence. Birds' nests were offered before these stones, and a most heterogeneous collection of crocodiles' skulls, saw-fishes' snouts, rays' tails, sharks' jaws, joss-sticks in small vases, clay figures of buffaloes, and sticks and stones of naturally grotesque shapes, was piled up round the figure, which was of Siamese design, and certainly did not recall the ordinary statues of the Buddha. The people call themselves Siamese, are locally believed to be Malays, and probably have a strain of Chinese blood in their veins. They dress in the Siamese fashion, and their speech is a rude dialect of Siamese, which even our interpreter from Singgora had some difficulty in understanding. The caves in which the nests are found are of much greater extent than that in which the collectors live; but they too are occupied temporarily by some of the islanders during the nesting season. Little offerings of rice, joss-sticks, and Chinese paper money are made outside the entrance of the most productive caverns.

The Siamese of Patalung, who are a very different people from the Siamese of Bangkok, or indeed from those who have settled in the Patani States or Kelantan, differ little in appearance from the cave-dwellers. They wear the same costume, the essential part of which is a kind of divided skirt, often made of pink cloth; to this is added a loose scarf, which may either be worn as a sash or carried hanging over the shoulder, or even wrapped round the head. The dress of the men and of the women is practically identical, except that the women wear tight-fitting jackets as a rule, and the men sometimes. The dark complexions, curly hair and thick lips of many of these southern Siamese probably point to a large admixture of native blood; and they practise one peculiar custom which is certainly not Siamese, being quite unknown either at Bangkok or farther south than Singgora. This custom is that of tree-burial, which is practised in Patalung in conjunction with the ordinary Siamese rite of cremation. When an adult person dies a "bad" or violent death, his corpse is rolled up in mats and suspended between two trees in a cigar-shaped case of split bamboos; it is left hanging until it rots away. Should he die a "good" or peaceful death, however, the body is placed in a kind of aërial coffin of planks until the bones are dry; the bones are then collected, and, after being kept for some time within the temple ground, are finally burned. The ashes are deposited in the nearest Buddhist temple. For the last ninety years the Government at Bangkok has been trying to abolish this custom; they have only suc-

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ceeded so far in making it disappear—I will not say become obsolete—in the immediate neighbourhood of the towns; but the priests, who do not object to tree-burial, complain that now the people are beginning to neglect the proper ceremonial in connection with hanging up the body and collecting the bones. Children are buried in the ground, beneath where the corpses of older people are suspended. The Buddhism practised in Patalung is of an even more degraded character than that of Bangkok, and shows a curious tendency in some instances towards animal worship. In Lampam the brother of the raja has set up a little shrine in which crocodiles' skulls are exposed upon a platform. Fishermen who go out upon the lake in stormy weather are said to pray before these to the guardian spirit of the crocodiles. The raja's brother is a very old man, but he is a noted slayer of crocodiles and a great magician, having once possessed a magic knife of potency, and, though the original knife was accidentally lost in the lake, having acquired another less potent but not devoid of supernatural powers.

Though the Malay of Kelantan is a very different person, physically and mentally, from the Siamese of Bangkok, it is difficult to draw an exact line between the two races, especially in Patalung and Singgora, where the Malays, while retaining their own religion, have adopted the Siamese costume and language; and where intermarriage has probably taken place to a much greater extent than the Mohammedans are willing to confess. In deportment and character the full-blooded Malay is almost as far from the gay and frivolous Siamese as he is from the Chinaman. His dignity is great; his sense of outward propriety and dress no less so, though in the Patani States he is less particular about the extent of his clothing than he is in Kelantan. In the former country, even in court circles, his "sarong"—which, as its name implies, is merely an "envelope" for the body—often is no longer than a Highlander's kilt, which it also resembles in that its many colours are arranged as a rule in a tartan-like check; but in the south of the Peninsula—in Pahang and perhaps even in Kelantan—it would be considered a deadly insult for a man to appear before the raja with his knees exposed. In addition to the sarong a scarf is generally worn, either floating loosely over the shoulder or wound round the waist, and sometimes a tight-fitting white vest, or a coloured coat, and a Javanese handkerchief twisted turban-wise round the head. The women, who enjoy very great liberty, wear a long straight garment that stretches from below the arms to the ankles in a most ungraceful line; and on their heads a narrow cloth is usually fastened, falling down on either side of the face, but not concealing it. Ladies who claim Arabic descent, or who have made the pilgrimage to Mecca, sometimes hold a corner of this cloth before their mouths, out of affected modesty; but the custom is not general. The Malays, who have a keen appreciation of the ridiculous, often laugh at women who do this. Among the "orang Islam" the standard of morality is higher than it is among the Siamese, the lower classes of whom even practise polyandry; and the Malay, though he is often an opium-smoker—without apparently being any the worse for it—is a good disciple of his prophet in this respect, that he drinks no strong

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drink. In Malay villages in the Siamese States it is impossible to obtain any form of alcohol except certain little rice cakes in which fermentation has been induced by the growth of a fungus. But the Malay is as cruel and thoughtless as a child, taking a positive pleasure in killing things which are powerless to kill him, and considering every form of barbarity fair in love and war. Perhaps it is the Buddhist religion which makes the Siamese comparatively tender-hearted. Once, I remember, we came across a woman who was suffering from the peculiar nervous disease called *lata*. Our Malays were eager to tease her by showing her a snake, and so cause her to exhibit her infirmity; but some Siamese who happened to be present were thoroughly horrified at the idea. The case, moreover, was typical. The Malay has no art higher than that of carving the hilt of the dagger, which, unlike the Siamese, he wears when he is permitted to do so; he has no native literature more exalted than the extravagant "histories" of his reigning families, though often he has read the Koran in Arabic: even at Singgora, boys who cannot speak a word of Malay are taught to do this. For the Malay is a Mohammedan, and Mohammedanism enters into almost every detail of his life—not that his monotheism, so often expressed, prevents him from invoking Hindu deities upon occasion, or from propitiating his native "hantu"—malicious nature spirits, all-powerful each in its own sphere, but too natural, too beast-like to have the semblance of divinity.

I have no time to describe the politics of the Siamese Malay States, had I the power; but two things impressed me most strongly with regard to them: (1) that the influence of Siam in the Malay Peninsula is rapidly becoming stronger, and (2) that it is for the benefit of the country that it should do so. The new civilisation of the Siamese does not extend very far beneath the surface; honest reformers like Prince Damrong and Phya Sukum are hampered not only by want of money, but also by want of men capable of understanding their aims. But in Lower Siam the reforms of Phya Sukum are being pressed forward in spite of every obstacle. Not only has the presence of a sovereign power produced peace between the various potentates of the country, not only are roads being made, but above all the cruelties and oppressions of the old order of things are being vigorously put down. The prisons are being cleansed, judicial torture suppressed, the fine art of murder abolished, the country reduced to order generally. Even the use of artificial spurs in cock-fighting has been declared illegal; and the corvée system, which, if properly regulated, I cannot help thinking to be a useful institution among people like the Malays, has ceased to be recognised in Singgora. In Kelantan, which is still fairly independent, and to which a Siamese commissioner was appointed for the first time last year, women are still beaten with lead-tipped rods in public, and the prisons contain cages in which men are chained up like wild beasts. In the Patani States, on the contrary, the implements of torture that we saw were evidently from their condition obsolete, and the convicts when not employed on public works wandered about freely except for shackles on their legs. In Patalung and Singgora, though here the Siamese have long been the predominant race, signs that they have lately become more

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powerful are not wanting; even in Mohammedan villages where the present generation only speaks Siamese, there are generally a few aged persons who remember some phrases of Malay. In the old kingdom of Patani, of which the seven smaller states became independent of one another after the Siamese invasion and massacre of 1832, every reform is still instituted in the name of the Malay rajas, though under orders transmitted from Bangkok through the Chow Kun, and through the Siamese commissioner stationed at each petty chieftain's court. The power of Siam is now sustained by diplomacy and not by force of arms; there is not a single soldier—unless the native armed police of Lampam, Singgora, and Patani can be called by the name—in the whole of the Siamese Malay States, and yet the Malays show no sign of rebellion. The Siamese having obtained the right, which no one now refuses to acknowledge, of nominating the heir-apparent in each State, during the lifetime of his predecessor, make skilful use of the reverence—one may almost call it worship—with which Malays regard kings born of the blood. In Patani itself a nominal interregnum has now lasted for some years, because the young raja showed himself too energetic and intelligent a youth to be altogether pleasing to his suzerain. The late raja died about five years ago, but the young prince is still called heir-apparent—in addition to enjoying a Siamese title; and, though he appears to have all the perquisites and most of the privileges of a reigning raja, he has begged for the title Raja Patani in vain so far. The Siamese States, unlike some parts of Siam, are happy in having no foreign politics, beyond a boundary dispute between the state of Rhaman and that of Perak, which is under British protection. Great Britain, apart from this dispute, which is probably settled by this time, has refused in the past to meddle with the internal affairs of the northern Malay States. French influence is only exerted on the other extremity of Siam. No other power has any excuse for interfering in the politics of this part of the Peninsula, as there is not a single missionary or other white man settled in the country between Ligor and Trengganu.

AN INDO-EUROPEAN HIGHWAY.

(*An Account of Colonel Mark Bell's views.*)

By S. H. F. CAPENNY.

HAVING been occupied with the commercial geography of Turkey in Asia and Persia, I have had occasion to look up a paper by Colonel Mark Bell which appeared in the *Journal of the Royal United Service Institution*, September 1899.[1] As that Magazine is not generally ac-

[1] The Highway of the Nations: *i.e.* The Turko-Persic-Indian Commercial Route between Europe and Asia, and the Considerations influencing its Alignment. By Colonel Mark Bell, V.C., C.B., Fellow King's College, London.—*Journal of the Royal United Service Institution*, vol. xliii., 15th September 1899. No. 259. Pp. 985-1016 (with a map showing the Commercial and Strategic Lines of Railway through Turkey-in-Asia and Persia to India, and their defence).

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cessible and Colonel Mark Bell's monograph seems to me of much importance, I have deemed it well to give a brief account of his views.

While it is the commercial aspect of an Indo-European highway with which I am most concerned, the strategical aspect becomes a chief consideration in discussing and determining the path of a system where it is necessary, above all things, that the line of communication should not only be well fitted to develop the economic possibilities of the territories through and between which it passes, but should also be well chosen in its direction and terrain for capabilities of defence not merely from local troubles along the vicinity of the permanent way but from foreign menace and dominance. Both aspects are duly considered by Colonel Bell. "A line of communication," he writes, "has a two-fold aim—a commercial as well as a military one: the latter, to enable military forces to occupy strategical vantage points from whence to prosecute a campaign with foregone chances of success; the former, so to run the line in subordination to the military aim that it shall tap the richest producing country, *i.e.* producing wood, grains, cattle, fodder, etc., and the luxuries of life, *i.e.* butter, cheese, milk, fruits, tobacco, etc. These two aims are always attainable together, for both military and commercial success depend upon communications and centres of supply and organisation, and commerce has been instrumental in forming these. The best commercial highway is the best strategical line as a rule."

Even if it seem that the strategical aspect is Colonel Bell's chief concern, as befitted a Magazine devoted to the Services, that will not come amiss probably at this time to the readers of the *Scottish Geographical Magazine*, most of whom will have been more or less occupied with strategical discussions as topics of the day. Strategy has been defined as "war on the map," and of the knowledge which it demands not least is that of military topography. There was an admirable article on military geography in this Magazine for March, and many will probably feel, who peruse it in the light of current discussions, that the *Scottish Geographical Magazine* might well lead the way in this direction, since Edinburgh's chief concern is education. "Public opinion," says Colonel Bell, "requires to be educated on the Eastern Question and menace, for if a policy is to succeed there must be a national feeling behind it." The readers of this Magazine who remember his paper on "Around and about Armenia," March 1890, need hardly be told that Colonel Bell's views are "the outcome of the toil of study and hard travel."

In his discussion of the problem which an Indo-European Highway involves, Colonel Bell keeps in view the needs, political and economic, of Europe as a whole, and not of England alone, in the hope that it may lead to a consistent European policy, determined by the true requirements of Europe and the East. He discriminates, however, between Europe and Russia, which he separates from the West. He thinks that "the southern expansion of the great Northern Power, now more a Power of Asia than of Europe, and whose centre of empire lies in Central Asia, out of her own sphere and into the zone of influence of Europe, and her too great solicitude to control commerce and religions

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and communications wholly within it, are dangers to Europe, and its further encroachments would lead to that power running rough-shod over her—a final overrunning of Europe by Asia." And he considers that "Russia's legitimate interests can be secured without her further southern expansion. The Black Sea is the outlet for her trade, and an outlet into the Persian Gulf is not vital to her commerce; what she seeks there is not a commercial outlet, but a naval base and arsenal; to understand this, the people of Europe must be taught the geography of Persia and Turkey-in-Asia."

The debatable zone between Europe and Russia is the belt of territory between Bandar Abbas, Basra, and Baghdad in the south, and Tabriz, Erzerum and Samsun in the north. The line of defence, which is the defence of Turkey-in-Asia and Persia, is the belt of country stretching from the Black Sea between the ports Samsun and Tirabzun in a general south-east direction by Sivas and Erzerum—Kharput, Bitlis, and Van—Mosul and Suj-Bulak—Kirind and Hamadan—Dizful and Gulpaigan to Shiraz and Bushire (Abu Shahr). This strategical field is divided into two zones, a hilly and a mountainous region, the one offensive, the other defensive. The former is the belt of the Armenian tableland from the sea-coast to the line Kharput, Bitlis, and Van; it consists of "grassy mountains and hills, fertile undulations, and rich agricultural valleys, generally difficult for military operations, with a climate for four months in the year of a severity to almost prohibit them, and traversed by few and difficult roads," but its plains, those of Erzerum, Pasin, Khanus, Bulanik, Mush, Alashgird, etc., grow grains largely. To the fighting strength of this offensive zone Colonel Bell would assign three-fourths of the fighting strength of Turkey-in-Asia, reserving one-fourth as a support to the troops holding the defensive zone. The latter zone is the belt of country stretching from the Kharput, Bitlis, and Van line to the Persian Gulf, and consists of the "mountainous country, difficult to traverse except by hill paths suited to pack transport only, and closed by snow for four or five months in the year, inhabited by unruly tribes, practically free of control, chiefly nomads, and subservient only in name to either Turkey or Persia." These mountains form the main watershed of both Persia and Armenia, and constitute the defensive zone. The primary bases to the left or offensive zone are the Mediterranean and Black Seas, and the secondary bases are along the line of Samsun, Tokat, Sivas, and Mardin. The primary bases of the right or defensive zone are the Mediterranean Sea for its north-west section to the line of Mosul and Suj-Bulak, and the Persian Gulf for its south-east section; its secondary bases are along the line from Iskandarun. Suwaidiya or Tarabulus (Tripoli) to Urfa, Mardin, Mosul, Baghdad, Kirmanshahan, and Burujird.

Colonel Bell assumes that for the defence of this belt three armies will be needed, which he terms the Eastern, the Western, and the Southern. The Eastern and Western armies operating in the offensive zone would be based upon the lines Mardin to the Black Sea and Mardin to the Mediterranean Sea, and the Southern or defensive army would be based on the line Mardin to Baghdad.

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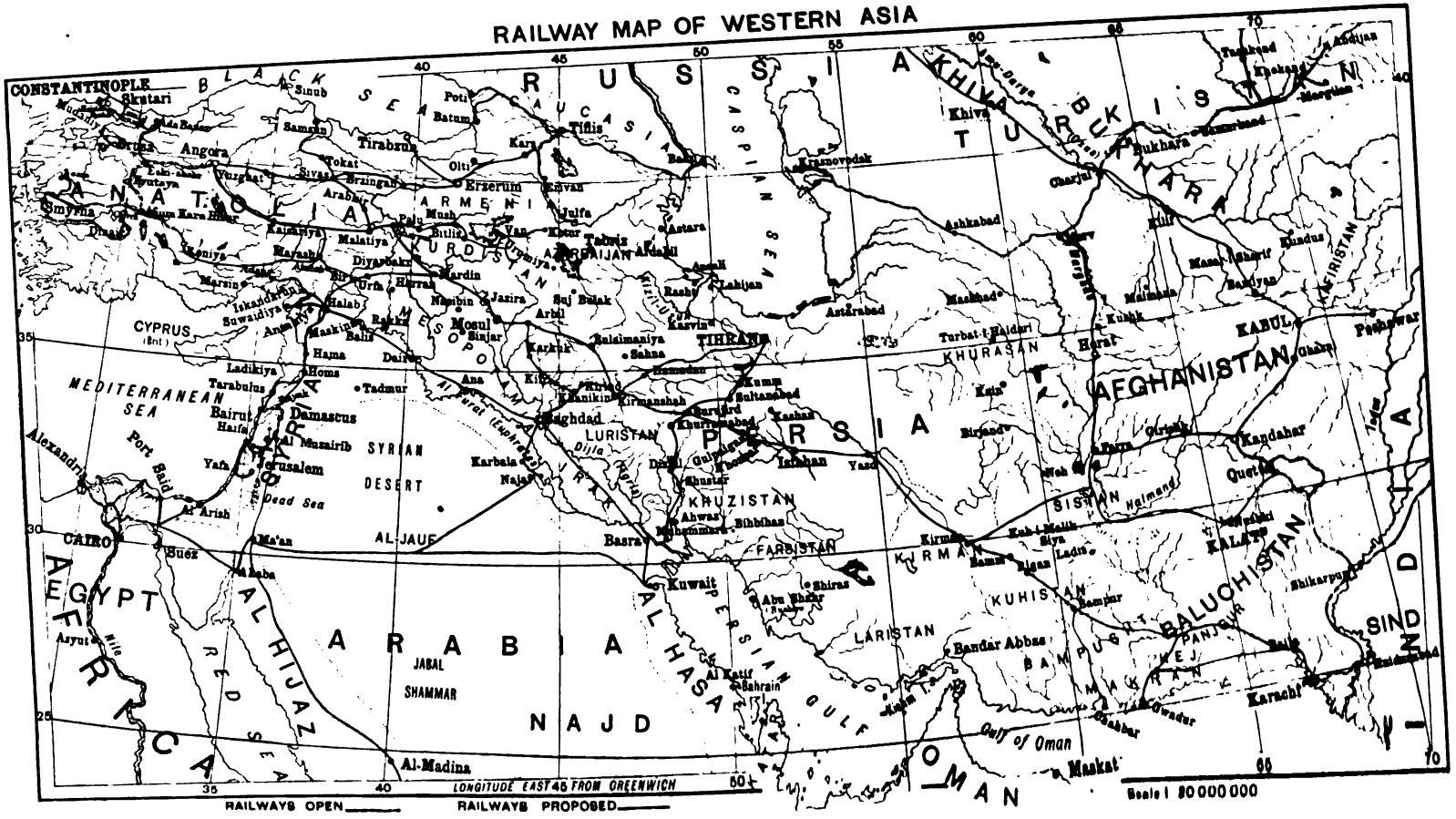
RAILWAY MAP OF WESTERN ASIA
CONSTANTINOPLE
Skutari
BLACK SEA
RUSSIA
CASPIAN SEA
ANATOLIA
ARMENIA
KURDISTAN
AZERBAIJAN
TURKISTAN
KHIVA
BUKHARA
TURKMANISTAN
Angora
Smyrna
Tirabzun
Erzerum
Batum
Tiflis
Baku
Krasnovodsk
Khiva
Bukhara
Charjui
Ashkabad
Kushk
Merv
Samarkand
Tashkend
Andijan
Khokand
Margelan
Tokat
Sivas
Erzingan
Van
Tabriz
Astara
Astrabad
Meshhed
Turbat-i-Haidari
Herat
KHURASAN
AFGHANISTAN
KABUL
Ghazni
Peshawar
KAFIRISTAN
Kunduz
Balkhya
Maimana
Lahijan
Rasht
Kasvin
TIHRAN
Hamadan
Sultanabad
Kum
Kashan
Isfahan
Yezd
Kerman
Birjand
Kain
Ghurian
Kandahar
Quetta
Jacobabad
Shikarpur
SIND
INDIA
BALUCHISTAN
KALAT
SISTAN
Helmand
Nushki
Nushki
Panjgur
Bampur
Bahu
Karachi
Gwadur
Jask
Gulf of Oman
Maskat
OMAN
PERSIA
PERSIAN GULF
Shiras
Abu Shahr
Bushire
Bushire
Bandar Abbas
LARISTAN
KUHISTAN
KIRMAN
FARSISTAN
KHUZISTAN
LURISTAN
Dizful
Shustar
Ahwaz
Bihbihan
Muhammera
Basra
Kuwait
Al Katif
Bahrain
ARABIA
NAJD
AL HASA
JABAL SHAMMAR
AL JAUF
AL HIJAZ
RED SEA
Al-Madina
Mecca
Jidda
Yambo
Ma'an
Al Ula
Hail
Aleppo
Alexandretta
Ladikiya
Homs
Hama
Tadmur
Tarabulus
Damascus
Beirut
Haifa
Jerusalem
Yafa
Port Said
Suez
CAIRO
Alexandria
Asyut
Nile
EGYPT
AFRICA
MEDITERRANEAN SEA
SYRIAN DESERT
Al Musairib
Al Arish
Dead Sea
CYPRUS
(Brit.)
Suwaidiya
Aleppo
Maskin
Rakka
Balis
Jarabulus
Mardin
Diyarbakr
Urfa
Harran
Nisibin
Jazira
Mosul
Sinjar
Arbil
Suj Bulak
Karkuk
Kifri
Khanikin
Kirmanshah
Baghdad
Karbala
Najaf
Dilja
Euphrates
Tigris
MESOPOTAMIA
Salaimaniya
Sahna
Kasvin
Zinjan
Miana
Tabriz
Julfa
Khoi
Urumiya
Lake Urumiya
Astara
Ardabil
Aras
Kars
Olti
Erzerum
Erzingan
Sivas
Tokat
Amasia
Zile
Yozgat
Kaisariya
Malatiya
Palu
Bitlis
Mush
Van
Marsovan
Tirebolu
Samsun
Sinub
Poti
Batum
Kara Hissar
Afium
Eski-Shehr
Brusa
Mudania
Ismid
Panderma
Dardanelles
Smyrna
Aidin
Denizli
Konieh
Marsovan
Amasia
Zile
Yozgat
Kaisariya
Malatiya
Palu
Bitlis
Mush
Van

What, then, are the facilities of communication which the needs of a modern army will demand? If Russia assumes the offensive from Olti, Kars, and Erivan to move upon Erzerum (the capital and key of Armenia) and Van, or pass beyond them, the main strategical positions which must be occupied for the defence of Turkey-in-Asia are along the line of Samsun to Baghdad. Colonel Bell reviews several of the railway schemes which others have proposed, but it will suffice to give his own views. He proposes, then, that a line should start from the Mediterranean Sea at Iskandarun, Suwaidiya or Tarabulus, and proceed through Halab, Bir or Birajik, Urfa, Mardin, Jazira, Mosul, Arbil, Karkuk and Kifri to Baghdad and Kuwait; as there is a military road from Tirabzun through Baiburt to Erzerum, the railway that is needed is from Samsun through Tokat, Sivas (a fine grain-producing district), Kharput (a mining district), and Diyarbakr (a commercial centre), to join the Mediterranean line at Mardin. Branch military lines are needed from Sivas through Erzingan to Erzerum; and from Kharput through Mush and Bitlis to Van.

If the port of Tarabulus is all that is desired, he would prefer the line from Tarabulus through Homs to Halab. He assumes that the Anatolian railway will be prolonged from Angora to Sivas and Kaisariya, and from Koniya to Adana and Iskandarun. Nevertheless, he thinks that this scheme may not do away with a Euphrates Valley line from Balis to Baghdad or to Kuwait, and a North Arabian line from Port Said to Najaf.

Colonel Bell further assumes, that for the defence of this belt a fourth or Persian army is desirable, and will be necessary if Persian territory is violated and Russia should operate from Khoi, Tabriz, Suj-Bulak, or Sahna through the Kurdistan hills. The strategical field of this Persian army would be Kirmanshah, Sahna, Burujird, and Hamadan, and it would be based on the lines Kirmanshah to Baghdad and Burujird to Shustar and Muhammara. He proposes therefore that the Mesopotamian railway, as determined by military necessities, should proceed from Baghdad through the Zagros Gates—*i.e.* by way of Khanikin and the Tak-i-girra—to Kirmanshah and Burujird, and be prolonged thence through Gulpaigan and Khonsar to Isfahan; that the navigation of the Karun be opened to Shustar, and a line of railway be constructed, forty-five miles in length, from Shustar to the foot of the hills, north of Dizful, and a cart-road by way of Khurramabad to both Kirmanshah and Burujird; and that the worst parts of the Karasu, Karkha and Karun be improved for the use of rafts, although it may be impossible to bring Kirmanshah through these waterways into navigable communication with the Gulf.

Colonel Bell assigns an important part to the strategical field of Kirmanshah, Sahna, Burujird, and Hamadan in the defence of both Turkey-in-Asia, Persia, and the Persian Gulf. This army could move on Tabriz, Khoi, Ardabil, thus flanking all the passes through the Zagros, or towards the Caspian. Besides protecting the eastern outlets of the passes across the Kurdistan hills to Van, it also protects the whole of south-west Persia from the line Hamadan-Isfahan to the Gulf, and prevents all passage through the Lur, Bakhtiyari, and Kashgai hills. The opening of river

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and cart-road communication from Muhammara to Burujird and Kirmanshah, and from Shustar through Bihbihan to Shiraz as well as through Ardal to Isfahan is necessary to supplement the Persian section of the railway, until such time as the country shall be ripe for the construction of a line of rails from Muhammara through Shustar, Dizful, and Khurramabad to Burujird, where it would join on to the main trunk line. The natural commercial prolongation of this line is through Hamadan to Tihran. A naval Power, he says, based on the Gulf, administering South-West Persia (from the line Hamadan-Isfahan, southward to the Gulf), with her advanced troops occupying this strategical field, is in a position to watch over the integrity of Persia, to prevent what is vital to Europe being seized by another, and to safeguard the overland railway route to Asia. This overland route is essentially a European one; it is a link in a communication demanded by the interests of Greater Europe, and is one of her highways in which all her eastern colonies and possessions are interested.

The problem to be solved is thus stated by Colonel Bell :—

I. How best to strengthen Turkey-in-Asia and Persia so as to justify the aid given to enable them to continue units amongst nations.

II. How best to aid these so-called Powers to defend themselves; and in defending themselves to defend European interests, so that it may be impossible for Russia to absorb them, and by so doing to become possessor of a line of communication of paramount European importance, and of seas and countries which would place her in a position to dispute with Europe, with every chance of success, the Empire of the East, and eventually with the aid of a million Turks to rule rough-shod over Europe itself.

The solution at which Colonel Bell has arrived is that the West must supervise the East, that Turkey and Persia must give heed to the wishes and good offices of Europe. The accumulated wealth of Europe must be put to use on remunerative works, such as roads, railways, harbours, and canals, to be administered by Europe. "A present sacrifice of means, energy, and talent," he says, "is required of Europe, to construct communications and public works in Turkey-in-Asia and Persia for their advancement and her own gain; thus leavening them, and leading by their means to a knowledge of just dealings; strengthening them by the development of their vast latent mineral wealth and agricultural resources; in a few words, treating them as weaker members. They on their part must gradually sacrifice, to entitle them to exist as nations, Oriental pride, apathy, rapine, and unjust dealings, and allow themselves to be guided by the stronger will. No one unacquainted with the East knows how soon and readily the Eastern will bends to the Western, and is benefited for good by it." It behoves Europe to fulfil the law of empire by serving her weaker neighbours and introducing law and security. "The Mesopotamian highways, when viewed in the light of their necessity to the improvement of Asia Minor, are European highways, and should in consequence be constructed by European capital and worked by international depart-

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ments, all nations being allowed to participate equally in their commercial advantage." The outlay is necessary as a European insurance, and is insignificant in comparison to the amount insured, while "a European administrative control would be as greatly preferred to a Russian absorption as a traditional friend is esteemed above a deadly foe."

Now that Germany has assumed her part in Anatolia, which Von Moltke desired in 1854, it is evident that Colonel Bell would assign to England as her strategic and economic field the belt of territory which may be described as Mesopotamia, Kurdistan, and South-West Persia.

"A circumstance that ought to be seriously considered," he says, "is that the keys of Persia and Turkey-in-Asia are held by neither Persians nor Turks, but chiefly by aboriginal nationalities still but partially conquered, and from whom taxes are gathered by force only. Reference is made to the Kurds, Lurs, and other wild tribes inhabiting the Zagros range, and the Arab tribes to their west and north. They have the spirit of independence amongst them, a spirit allied to that of Europe—that of freedom, and opposed to that of Russia—serfdom. Within, and to the immediate rear of these hills, the plains stretching to the Gulf and the Euphrates, lie the keys to the Eastern Empire necessary to the security of Europe.

"The control of this belt, the superintendence of its revenue and its expenditure, from the line Van-Urfa, in a south-east direction, to the lines Muhammara, Burujird, and Abu Shahr, Shiraz, together with the construction of the public works advocated, suffice to put Europe in the position required for her own safety, and, as well, that necessary to safeguard that of Turkey-in-Asia and Persia, and keeps Russia for ever in her own sphere.

"Loss of territory, by giving up districts to be controlled, does not mean loss of revenue to the giver, but the reverse; by sympathy it also necessitates the better government of the remainder. A well-governed region will pay for the public works necessary to develop it, for the army necessary to ensure its tranquillity, and leave a handsome surplus. Indeed, so unable are Turkey and Persia to govern these districts that their alienation would be to them a source of strength and an infinite boon to their inhabitants.

"In its various parts it is rich in the sinews of war, *i.e.* men, transport animals, grain, fodder, butter, milk, firewood, etc. The Lurs and Kurds and certain Arab tribes are composed of men whose pastime, till recent years, has been war and plunder; they are good sportsmen, hardy and courageous. Luristan is a breeding-ground of mules; donkeys abound; the Arab horse is reared in the Mesopotamian plains; the camel abounds; grain is abundant in all the valleys—those of the Tigris, Euphrates, Karun, Hindiyan, and lesser streams; the fodder in the Zagros hills is inexhaustible, and there sheep, cows, butter, and milk are plentiful; oak and other trees are found in abundance in certain zones of the hills, etc. The nature of the rivers and the lie of the country generally favour irrigation. Such a country is worth, to a commercial company, a thousand new Borneos, and is of equal value to a second India."

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Colonel Bell assumes that India and Afghanistan are secured by a position taken up about the bend of the Halmand connected by rail with India and the Gulf, the strengthening of the secondary base Kabul, Kandahar, by rail to Kabul and Kandahar, and the control of the country to the Hindu Kush. His chief concern is about the belt of country from Kurdistan to the Persian Gulf, where the contest must be fought between Europe and Russia for the Empire of the East.

"If the belt is occupied by Russia," he says, "the doom of both Turkey and Persia, the Persian Gulf and the Dardanelles, is sealed, and she will have gained a position from which she cannot be ousted, strengthened as it would be by art and backed by millions of soldiers.

"Occupied on the offensive-defensive principle as already suggested, it forms an impregnable position against which an invader would break his strength. The difficulties of ground, if enlisted on the side of the defensive, multiply its strength; if given over to the offensive, defence is impossible except by prohibitive numbers.

"A few years back the line of the Caucasus could have been held from sea to sea on the defensive, and Turkey-in-Asia and Persia for ever protected; the opportunity was lost, and the chief defence of these countries fell to Russia. But one more defensible belt is left; it is the last line of defence, and if it be lost the opportunity of protecting them has gone for ever. If Russia be allowed to possess herself of the western outlets of the Kurdistan range leading into the plain of Mesopotamia, nothing can prevent her from overrunning them at will, and thus to obtain her greatest desires—a Mediterranean sea-board; the security, even from menace, of her southern borders in the Black Sea; and the monopoly of the Black Sea route."

In this strategical scheme with its communications and works Colonel Bell has in view not only the defence of Turkey-in-Asia and Persia but the security on behalf of Europe of the most feasible line of communication between Europe and the East. He proposes that the line from Baghdad to Kirmanshah and Isfahan should be prolonged through Yazd and Kirman to Sistan, whence it may join the Indian system. In *Blackwood's Magazine*, July 1889, writing in behalf of the Karun route, which he regarded as a link in the chain of communication between East and West, paving the way for a railroad to Isfahan, Tihran, and Kirmanshah by way of Burujird, he said, "There *is* a future before this route if only the Persians will open up the feeding lines necessary to its development. Commerce and the wants of Baluchistan and Sistan call for an early extension of the Pishin line to the latter fertile oasis, and it cannot without danger be long delayed. It is a link in the military route of the future, which must eventually traverse Persia from east to west, from Sistan to Isfahan and Kirmanshah." He strongly supports this Mid-Persian highway, both on military and commercial grounds, as the Persian link in the Indo-European chain of communication, and puts aside a possible line through Tihran and Mashhad on account of the propinquity of Russia along the whole of the northern border of Persia, as well as the lines from Baghdad through Shustar or Ahwaz, Bihbihan and Shiraz to Kirman and Sistan, and that from Basra through Abu Shahr

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and along the coast to Karachi. These latter lines are defective commercially as well as strategically.

Such, then, is the line of communication which Colonel Bell chooses for the Indo-European highway. It has been my aim to give a concise account of his views, making use as much as possible of his own words. It is beyond the scope of this article to discuss the scheme, but one or two things may be indicated for consideration.

With regard to the ports, it is necessary to notice that the Anatolia railway now terminates at Angora and at Koniya, and that it is proposed to prolong it from Koniya through Mar'ash to Bir on the Euphrates. As the report of the Technical Commission has not yet seen the light, it remains in doubt what the direction is between Bir and Baghdad. Smyrna is now connected with the Anatolian railway by the Smyrna-Kasaba line which belongs to a French company, but access to the system is to be denied, it seems, from the Levant ports, such as Marsin, Iskandarun, Suwaidiya, Tarabulus, Bairut, and Haifa. It is said that the line from Koniya to Mar'ash is not to pass through Adana; and the proposed line which leaves the Bairut-Damascus at Rayak is not to go farther to the north than Hama. The possibility of Haifa (or Akka) as a port comes, therefore, into consideration as probably the most feasible for a Britannic highway.

It is reported that Russia intends to build a line from Kars to Erzerum, and from Tirabzun (Trebizond) to Erzerum. The American Consul at Sivas recommended in the spring of this year a line from Samsun to Baghdad to compete with the German line, but that port has now come within the sphere of Russia.

On the side of India it is necessary to keep in mind that Sir Robert Sandeman and Lord Curzon have both recommended a line from Karachi to Kirman, apart from a line between Quetta and Sistan. The caravan highway through Nushki, which has been developed within the last decade both to Kirman and Khurasan, is one of the lines of communication which Colonel Bell has in view, but there is much to be said in behalf of a line from Karachi through Kej, or through Panjgur to Bampur, Rigan, Bamm, and Kirman.

There is no doubt that the best line of access to the tableland of Iran is from Baghdad through the Tak-i-girra or Zagros Gates between Khanikin and Kirmanshah (or Kirmanshahan, as the town is named distinct from the province). From Mosul the Indo-European highway would pass through Arbil, Karkuk, and Kifri to Kasr-i-Shirin at the foot of the Tak-i-girra, or meet the Baghdad line at Khanikin. But as Colonel Bell keeps in view the possibility of a railway from Muhammara and the Karun to Burujird, it may be well to keep in view the possibility of a line from Mosul to Kirmanshah, by way of Arbil and Sulaimaniya, as a link in the chain of Indo-European communication. Sulaimaniya is the capital of Southern Kurdistan, has a temperate climate, and commands several lines of communication, but itineraries are few and the topography of the district demands a personal visit.

It is, however, between the Syrian coast and Mosul where the possible lines demand to be thoroughly considered in all directions and

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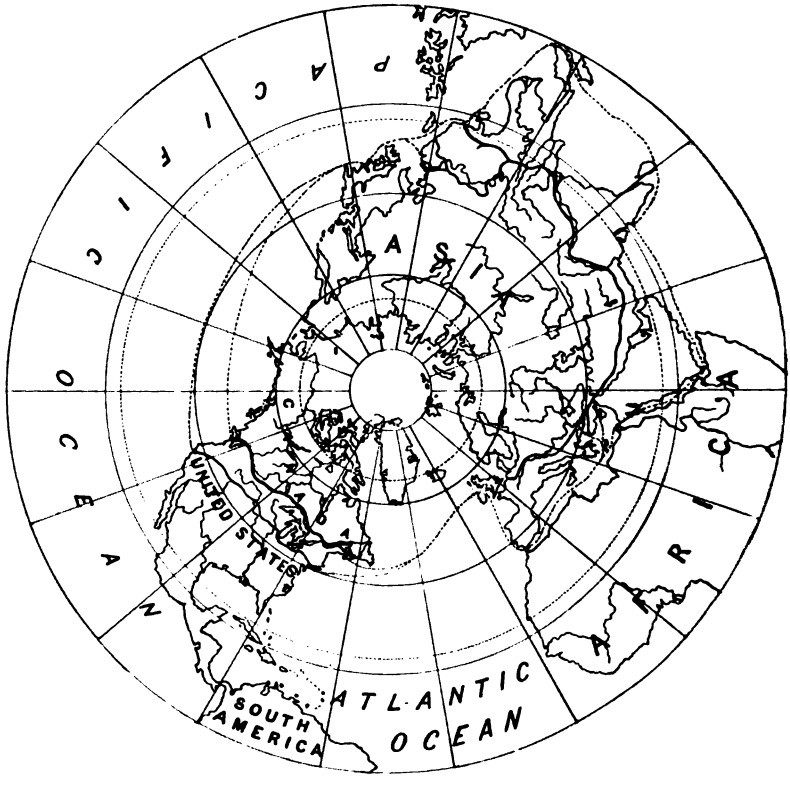
from different points of view. If Iskandarun is the port decided upon, there are three lines of access to the district between Diyarbakr and Mosul: first, from Bir to Diyarbakr through Urfa and Suverek, or through Sumaisat and Suverek; second, from Bir to Mosul through Urfa, Mardin, and Jazira, or Mardin and Nasibin; third, from Mambij (north-east of Halab, between Bir and Balis or Maskina) to Mosul through Harran. Owing to the formation of the terrain between the Euphrates and Tigris from Bir to Diyarbakr, or Mosul through Urfa, the construction would be both difficult and costly. It has therefore been proposed to build the line from Mambij, with branch lines to the chief towns in the north. But this would be a considerable defect in any line regarded as a commercial highway, with the chief commercial



town off the main railway. The strategical considerations of Colonel Bell support the commercial. Commerce and strategy, he says, adhere to natural directions: the best base and line of communication combined will also be the best commercial line. Hence he proposes, in view of the military importance of the Mardin district, that the line from Iskandarun proceed from Bir through Urfa to Mardin, and thence to Diyarbakr on the one hand, and Mosul on the other. Angora will probably in time be connected with Diyarbakr through Yuzghat and Sivas, Kaisariya and

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Sivas, or Kaisariya and Malatiya, by way of Kharput. Since, however, the Anatolia railway is to be prolonged from Koniya to Baghdad, it becomes of much importance at this time what the direction is to be from the Euphrates to the Tigris. It is said that the German Technical Commission has reported on the great difficulty of this tract, but it will be seen that many considerations of great moment support the line of communication which is the most feasible commercially, if the most costly in the building. "That a correct choice should be made," says Colonel Bell, "of the best commercial and strategic line between the Mediterranean Sea and India, so as to answer all the requirements of commerce, of defence and offence, is of the highest importance. A wrong choice cannot be rectified except by costly expedients, and may cripple military action or render it wholly abortive; a strong line as to defence, well selected as to the offensive, must compel the enemy's movements to conform to your initiative. All the advantages are gained of a pre-arranged campaign on a definite plan. The best strategic lines of communication, even if the longest, will generally run through the most important provinces and the most flourishing towns; main communications and not by-ways are most appropriately used for strategic purposes, and these are the arteries of commerce." It is to be hoped that the decision of the Anatolian Railway Company will meet these commercial and military demands of a European highway to the East.

Colonel Bell has considered this problem of the defence of Turkey-in-Asia and Persia as the defence of the world's commercial highway to the East, and of Europe's strategic road across Mesopotamia to the Persian Gulf. In considering the highways that radiate from Europe as a centre he notes:—

I. West-south-west to Canada and the eastern ports of the United States; across America and Canada by rail; and thence south-west and south-south-west to Australasia, China, and the Far East.

II. South-south-west to the coast of South America, and *viâ* Cape Horn to Australasia and the Far East.

III. An Intermediate line, south-west, to the West Indies, and eventually by the Panama Canal.

IV. South-south-east and east to India, and *viâ* the Cape of Good Hope.

V. The Mediterranean, the Suez Canal and Red Sea.

VI. The Mediterranean Sea and Mesopotamia to Mosul and Baghdad and the Persian Gulf, and from Baghdad through Mid-Persia to join on with the Indian rails, extended westward to Sistan, and eastward to the Yang-tse-Kiang, opposite Hankau.

This Mesopotamian line, with or without its extension through Persia, is the shortest line from Europe to the Far East, and civilisation demands that no link shall be wanting in this chain of communication. "The security of an international route," says Colonel Bell, "is of first importance, and each link in its chain should fulfil its purpose, and be controlled by a European nation; and this may not be too much to expect when Europe realises that a common danger requires that she

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shall sink all internal jealousies, and stay the progress of a Power that may become strong enough to threaten its liberties and freedom of intercourse with the East." This Indo-European Highway is a European concern. "If it can be shown," he says, "to be a secure line, or to be capable of being rendered secure, and, as well, capable of satisfying the requirements of European commerce, it is elevated at once to the rank of a first-class commercial highway. If also it can be shown to be essential to the integrity of the kingdom of Turkey-in-Asia and Persia, and to be an absolute necessity in order to strengthen them, both materially and administratively, so as to make it possible that they should justify their very existences as units amongst the civilised nations now closing in on them, this commercial highway becomes a European strategic one of the very greatest importance, and one the development of which should not be delayed."

While it behoves Europe to see to this Indo-European highway to the East, it is also regarded by Colonel Bell as a World Commercial Highway. It is described by him as "the centre girdle of the earth, connecting by the shortest line the Atlantic and Pacific Oceans; the highway between East and West, and hence called by us the 'Highway of the Nations,' and, in conjunction with the Panama Canal, the shortest girdle likely to be put round the globe, and of great importance to the two Americas."

SPITSBERGEN, 1898 AND 1899: VOYAGES WITH H.S.H. THE PRINCE OF MONACO.

By WILLIAM S. BRUCE, F.R.S.G.S., M.B.O.U.

With Photographs by the Author.

(*Read before the Society in Edinburgh, Glasgow, Aberdeen, and Dundee.*)

DURING a cruise in the Barents Sea with Mr. Andrew Coats in 1898, I first saw Spitsbergen. With the *Blencathra* we had already visited Kolguev and Novaya Zemlya, and were then in the middle of July, heading for Wyches Islands, when Edge Island was just visible to the westward. Hope Island at the same time, bore ESE on our starboard quarter. Later on, during the return voyage to Europe, we saw the same land at a much less distance; heavy clouds lay over the rounded hills and mingled with the patches of snow and glacier ice in the ravines and valleys, while mist, rain, sleet, and a nasty head sea made life on board ship decidedly dull and uncomfortable. To the northward could be seen Stone Foreland, and abeam of us lay Half Moon Island, while ahead of us, on our starboard bow, were the Thousand Islands. Passing to the southward of these islands, an outlying reef as yet uncharted, made us unpleasantly realise how dangerous and difficult navigation is along this almost entirely unsurveyed coast. The existence of these islets in uncertain positions, and of submerged rocks, sufficiently accounts for our ignorance of one of the largest islands of the Spitsbergen group. At the beginning of August during the same year, I again visited

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Spitsbergen, His Serene Highness Albert, Prince of Monaco, having kindly invited me to return with him from Tromsö. After visiting Bear Island and Hope Island, the yacht *Princesse Alice* steered for South Cape, sighting this peaked southern extremity of Spitsbergen on August 2nd. A more or less northerly course was steered up Stor Fiord (the Great Fiord) along its west side, and a magnificent view of its mountain ridges and peaks, separated by great glaciers flowing down broad valleys, unfolded itself to us. Each glacier terminated with a perpendicular ice face in the sea. No sign of the "*Low flat island*"—marked in the British Admiralty charts off Whale's Head—was seen, though a bank is said to exist there. Towards Agardh's Bay the land becomes less peaked, and the rocks exhibit strongly marked horizontal stratification with cliffs above crumbling into talus below. These rocks appear to be an extension of the Triassic and Jurassic series of Sassen and Advent Bays. Passing Wiche Bay, we came face to face with the giant Negri Glacier, which forms the termination of Stor Fiord before entering Ginevra Bay. We remained in Ginevra Bay for some days, anchoring on the north side of Changing Point, Barents Island, and made numerous excursions on land and in the steam launch. We then visited in turn Advent Bay, Sassen Bay, and Klaas Billen Bay, in Ice Fiord; and afterwards Danes Island, Amsterdam Island, and Graves Point in Smerenberg Sound. A very considerable portion of the time was spent in deep-sea work to the N, NW, and SW of Spitsbergen.

Last summer the Prince again asked me to accompany him. I joined the yacht *Princesse Alice* on the 21st of June at Havre, and we sailed the following day. The Prince's scientific staff included Captain Carr, Dr. Jules Richard, Captain Guissez, Dr. Portier, Dr. Chauveau, M. Fuhrmeister, Mr. William Smith (of Aberdeen), and myself. Our first port of call was Kiel, the German Emperor having invited the Prince to come during the Kiel regatta week. After we passed through the Kaiser Wilhelm Canal, the Emperor sent a naval officer, who was to be attached to the Prince's staff during his stay in Kiel. We passed along a line, stretching nearly the whole length of Kiel harbour, of about thirty great battle-ships and cruisers, besides a great number of torpedo-boats, destroyers, and the like. The *Hohenzollern* lay towards the southern end of this great fleet, the *Princesse Alice* mooring to a buoy reserved for her close by. Dotted all over the harbour were innumerable sailing yachts of all sizes that had come to take part in the races. After some days, during which the Emperor was on board the *Princesse Alice* several times, and we on board the *Hohenzollern*, we left Kiel for Bergen. At Bergen the anchor was dropped in the west harbour between two training-ships, one being German and the other French. The Prince received the officers of both these vessels, as well as the commanding officer of the Bergen Fort, afterwards returning the respective visits. During these visits the usual salutes were fired. Soon after, the *Hohenzollern* steamed into Bergen, and a scene of historical interest was to be enacted. In compliment to the French, the Emperor not only dipped his ensign, but also hoisted the French ensign on board his yacht. Again the customary visits were paid by the officers of the fort and ships to the Imperial

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yacht. In returning these visits, the Emperor further showed his friendship to France—for it was the first time a German emperor had set foot on a French warship since the Franco-Prussian War. He also sent a complimentary telegram to the President of the Republic congratulating him on the efficiency of the midshipmen. Next day he arranged a soiree on board the *Hohenzollern* in order to enable the officers and midshipmen of the French and German training-ships to meet each other. The Prince and his scientific staff were also among the company. After these festivities we left for the north. At Tromsö the Empress Eugenie hospitably entertained us on board her yacht *Thistle*, inviting us to accompany her on a visit to Lyngen Fiord in order to see the glaciers which, in that fiord, almost reach sea-level. These are of extreme interest when compared with those of Spitsbergen, and with those that used to exist in other parts of Norway, Scotland, and elsewhere. It was quite clearly seen that these glaciers are only the remnants of what were once much larger glaciers, and probably then tributaries, which ran into a great glacier filling up the whole of Lyngen Fiord. All along the Norwegian coast it is interesting to note the strongly marked glaciation in the low-lying ground, while the peaks are jagged and sharp, evidently having been exposed to atmospheric denudation when the valleys were filled with ice—a condition which exists at the present day in Spitsbergen, and which I shall be able to show you presently on the screen.

Our destination now was Liefde Bay, in the extreme north of Spitsbergen, nearly 800 miles distant. The bursting of the steam pipe of one of the boilers compelled us to return to Tromsö, and delayed us three days. We filled up our time by visiting the Lap encampment on the mainland, and by making general natural history collections. On July 25th we sighted Prince Charles Foreland, its southern extremity standing out like a separate island from the northern end, both ends being mountainous with low-lying ground between. The following morning, at 6 A.M., NW of Smerenberg Sound we met the outermost streams of the Polar pack-ice. On our starboard hand lay Dane's Island and Amsterdam Island, as we steamed along through the "brash ice" along the edge of the "pack." The weather was dull and overcast, as so frequently is the case on the borderland of ice and open sea. (The whalers say, "Where there is fog there is open water," for when they are cruising in search of whales through densely packed ice, and are perhaps beset and can see no water from the masthead, yet if they see fog to the northward they push still farther into the pack, for then they know there will be a large piece of open water where they are likely to find whales. Conversely to the whaler, an Atlantic skipper would suspect ice when there is fog in certain localities, and would try to avoid it.) The stratus clouds descended down to about 1000 or 1500 feet, hiding the peaked summits of the NW of Spitsbergen. At 8 A.M. the low-lying Red Beach was reached, to the eastern extremity of which lies the entrance to Liefde Bay. But alas! a stream of ice too heavy for our steel yacht to venture through blocked the entrance of Liefde Bay. The temperature of the air was 37·4° F., and that of the sea 36·5° F. Fulmar petrels (*Fulmarus glacialis*) were flying around in great numbers,

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LAKE DEVEER, GREAT NEAT, PORTION AND SUMMERBERG GLACIERS, WITH A.V. TUNNEL AND ALASKA AT ANCHORAGE.

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and myriads of litle auks (*Mergulus alle*) were swimming in the water. The shrill cry of the beautiful ivory gull (*Larus eburneus*) could be heard following some sealing sloops, which were sealing along the edge of the ice. Every now and then a seal would come along and examine us with its large soft eyes.

The Prince had intended to make a thorough hydrographic survey of Liefde Bay, but the presence of this ice made it impossible for the present. He was now carefully cruising westward along this northern coast, and was off the entrance of Red Bay, when it occurred to him that it might be of interest to examine that bay, especially as it did not appear in any way to resemble that marked in the chart. Keeping two leads

LAKE RICHARD AND NE. END WITH SMALL LAKES, LAGOONS, AND SEA.

going constantly, one forward and the other aft, the *Princesse Alice* entered Red Bay. It was soon quite obvious that the British Admiralty chart was absolutely wrong, and that where a shallow bay was charted we were entering into a deep, narrow fiord. This is only one example of many in Spitsbergen, where the coast-line is charted in *entire*, when it ought to be in *dotted* outline where it is practically unsurveyed. Although hundreds of tourists go to Spitsbergen now every year, and quietly imagine they are sailing over well-charted seas and coast-lines, they are in reality encountering considerable danger, especially in the large ocean-going steamers which visit its shores. Bit by bit we worked our way southward into this fiord (for it is a "fiord," and not a "bay"), sounding carefully fore and aft all the time, and eventually anchored in about eight fathoms behind a prominent point entirely closed in from the open

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BEN NEVIS (Highest peak - 4080 feet), MONT SOCHIB, AND OBAND GLACIER [illegible] KLINCKOWSTRÖM BAY

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sea. The Prince of Monaco has since honoured me by calling this Point Bruce.

Scarcely had the anchor been dropped and a boat lowered, when Dr. Richard and I—who had been standing by ready with guns, vascula, fishing-baskets, and with every available pocket filled with bottles and tubes for specimens of various kinds—proceeded to go on shore. It is an excellent rule on board ship always to be in readiness to jump into the first boat which is going ashore. We landed at the base of Point Bruce, and proceeded in an easterly direction over rising ground. On attaining the top of a ridge of 300 feet high we discovered a hitherto unknown fresh-water lake, about four miles in length and about one mile in breadth, in a valley stretching for about six miles in a north-easterly direction. Great was our satisfaction, for in this lake we knew there must be at least a certain number of animals representing the fresh-water fauna of Spitsbergen. Dr. Richard, who is well known as a specialist in fresh-water crustacea, was able to secure a considerable number of interesting examples of these little-known Arctic animals, though there were fewer than we had hoped to find. The Prince has since named this fine lake "Lake Richard." The lake is fed from water and melted ice and snow from the north-easterly side of the ridge we first ascended, and from the hills that rise from 1100 to nearly 2000 feet on each side of the lake; at its north-easterly end it breaks up into a series of small lakes and pools, with intervening streams, which flow into a large lagoon opening to the sea. Above this lagoon is a glacier, the only one coming down into this valley. The terminal streams and lakes already referred to flow over strongly marked glaciated ground formed of hard ice-polished rock. I have no doubt this valley has been very largely moulded by a great glacier which once flowed through it, probably in a north-easterly direction into the sea. Crossing one of the streams, Dr. Richard and I proceeded back to the ship along the south-east side of the lake—thus completely circumventing it. At the south-westerly end Dr. Richard secured a small specimen of *Salmo alpinus*, sufficient evidence for us to come to the conclusion that there must also be larger salmon in the lake. I don't know if there are any fishermen present, but in case there should be, I will tell them how to catch salmon. You take a stick; tie a piece of string to the end of that stick, fixing on an ordinary hook at the end of it, upon which you put a piece of beef for bait! It was after this fashion that the laboratory attendant secured us a fine basket of salmon the next day, consisting of more than a dozen fish, each weighing between 3 and 4 lbs. It may be mentioned that insect larvæ were found in the stomachs of these salmon.

Every day we went over fresh ground making new discoveries, or studied in greater detail parts that we previously passed over, but I will presently describe this Red Bay as a whole, and not bit by bit as it was laid out to us by each of our numerous excursions.

On the 1st of August the Prince landed Captain Guissez of the French Navy, and a party to carry on the hydrographic survey of Red Bay, an encampment being made on the north side of Point Bruce. Captain Guissez, whose surveying work is already so well known on the

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INTERIOR OF SPITSBERGEN [illegible]

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Mekong River, had been busy with his staff since our landing in placing a number of signal-posts in prominent positions all round Red Bay for his survey work. The central point of observation was a cairn on Bruce Point situated in lat. 79° 45′ 22·5″ N., and long. 12° 15′ 28″ E. (Greenwich),[1] and the "base-line" was to a post on the ridge at the south-west end of the Lake Richard valley. After lowering away the "nasse," *i.e.* a huge lobster-creel, in fifty fathoms off the extremity of Cape Beijer—the summit of which is named after Captain Carr—the *Princesse Alice* visited Advent Bay, in Ice Fiord. Here we met the Rev. Mr. Bonnar of Saltoun, who, with two Edinburgh gentlemen, was carrying on scientific observations mainly in ornithology and

INTERIOR OF SPITSBERGEN

FROM SUMMIT OF BEN NEVIS LOOKING SW.—GRIMALDI RANGE, ALBERT PEAK, AND GRAND GLACIER.

botany. He has since given an account of this interesting work to the Scottish Natural History Society. His Highness invited Mr. Bonnar on board, and during lunch and in the afternoon we compared notes, especially as regards birds. After two days the Prince returned northward again, and on the 4th of August anchored in Magdalena Bay. Magdalena Bay is a small bay or fiord to the south of South Gat, the southern entrance to Smerenberg Sound. It is six miles long and about one and a half miles broad. It faces the west. On the south side is a convenient point behind which sloops and small vessels can anchor safely in heavy weather, but there is no safe anchorage in bad weather for a vessel the size[2] of the yacht *Princesse Alice*. Three glaciers reach the sea on the

[1] Four observations for latitude and thirteen observations for longitude were taken.

[2] The yacht *Princesse Alice* measures: length, 245 feet; breadth, 35 feet; depth, 18·2 feet; drawing about 13 feet of water.

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south side, and one almost reaches the sea on the north side. At the end of the bay is Waggonway glacier, which is fed by several tributaries. There is little doubt that by ascending this glacier one could make fairly easy access to Red Bay, reaching the southern extremity of Grand glacier and travelling down it to the head of Red Bay at Cape Beijer. On the 15th it was threatening to blow from the westward, so the Prince judged it better to leave Magdalena Bay and proceed to Red Bay. Passing through South Gat, where again the land survey at least is very incomplete, we entered Smerenberg Sound, passing northward along its eastern side. At the SE corner is a notable glacier unnamed, with four great feeders. I believe Red Bay could be

THE ENCAMPMENT ON POINT BRUCE, 10th of August 1899.

reached, *viâ* Chauveau glacier, by ascending this glacier: both this and the Waggonway glacier crossings would be of great interest in order to acquaint us more thoroughly with the interior of Spitsbergen. We steamed through Fair Haven, north of Foul Bay and between Inner and Outer Norway Islands, going dead slow and keeping the lead going continuously, and rounding Flat Hook, again entered Red Bay on the afternoon of August 5th. The clouds were down to about 200 feet, and it was drizzling and cold. Entering carefully, we passed Point Bruce, and headed very slowly for Cape Beijer, where the "nasse" was buoyed out in fifty fathoms. It was gone! Ice had come by and carried it away, and after in vain looking for it we had to abandon the search and do without the rich zoological treasures which we had eagerly been hoping to secure.

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We were approaching at less than half speed to our former anchorage, and were about half a mile off, in soundings that we had previously found to be about ten fathoms, when suddenly a shock and grating sound only too realistically told us that our good ship was hard and fast on a rock! Fortunately upon examination our craft was making little water, but all attempts to liberate her failed! Full speed astern, porting and starboarding the helm, going ahead, hauling on a kedge anchor and letting go again were alike unsuccessful, and she did not budge an inch! All the boats had been lowered; one had gone ashore to bring Captain Guissez aboard to ascertain what the tides were. As bad luck would have it, we had grounded at high water. Seeing the

TRURENBERG BAY.

SHOWING SWEDISH STATION, S.Y. "SVENSKSUND," AND S.Y. "PRINCESSE ALICE."

very bad state of affairs, and even the possibility of having to abandon the ship and of wintering, the Prince ordered the launch to be got ready to take the storekeeper's wife and another woman to Advent Bay, over one hundred and fifty miles distant. The Norwegian pilot Johansen, the Scotch whaler Wedderburn, the second engineer, a Frenchman, and a Brittany seaman—truly a cosmopolitan crew!—undertook this journey, which on account of bad weather which sprung up was very adventuresome. They successfully accomplished their mission, however, returning somewhat weather-beaten after their three-hundred-mile voyage. At the same time the Prince asked me to organise an encampment on shore, along with the help of Dr. Richard and the scientific staff. By the fourth day Dr. Richard, Dr. Chauveau, M. Fuhrmeister, Mr. Smith, the laboratory attendant, the cook's mate, and myself, had sleeping accom-

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modation on shore for all told, namely, sixty in all, and had landed coal enough for a wintering, and provisions enough for three or four months. Meantime, heaving over nearly all the coal, buoying out heavy anchors and chains, moving iron from forward aft, and at one time keeping ice off the ship, was the work to be done on board, and the Prince was foremost in the work. At eight different tides attempts were made to release the ship, but to no avail; but on the fifth day, at the ninth tide, she at last floated. We at the encampment on Point Bruce stood by to witness the release; we raised a cheer, hoisted a piece of canvas for a flag, and fired a salute with five guns. To add to our discomfort, there had been continuous sleet and rain, fog and wind during these five days, and as we had no time to change we were soaked to the skin. Coming on board, the Prince shook us heartily by the hand, and thanked us for the help we had given him, and we congratulated him on the release of his magnificent yacht from destruction. It is a remarkable fact that out of 2400 soundings taken in the survey of this fiord, not another rock was found that we could have run upon!

But to proceed to the description of Red Bay. It is a fiord twelve miles long and four miles broad, running southward into the north coast of Spitsbergen between Liefde Bay and Smerenberg Sound. Seven great glaciers run down into the sea on its western side, and there are also some minor ones not reaching the sea. These come down from a high ridge of land 2000 to 3000 feet high, running between Red Bay and Smerenberg Sound; and in nearly every case the whole course of each glacier can be seen filling up the valleys between the peaked mountains of Archæan schists and granites, which are in nearly every case richly clothed with black lichens. At the foot of each cliff and talus, between the glaciers, is a raised beach rich with vegetation. In contrast to this western shore, the eastern shore is free from glaciers. One third of the way down is Point Bruce, and from the base of this, Lake Richard valley runs in a north-easterly direction towards the sea. This valley is almost entirely filled up by Lake Richard. There is high land on the NW and SE side of the lake as before mentioned, and a second valley with other two lakes, likewise rock basins, each about a mile long, lies to the south. The ground to the south of this is hilly, and attains its maximum height in a mountain which I climbed, and which the Prince permitted me to call Ben Nevis, in honour of the highest of Scottish mountains and in recollection of the interesting and instructive time I spent while in charge of the summit observatory. At the southern extremity of the fiord are two great glaciers, Grand and Chauveau glaciers, separated by Cape Beijer and Hirondelle Point. The eastern side of the fiord consists, as far as I am able to judge, of Silurian and perhaps Devonian rocks. Upon this I cannot make a final statement, as the rocks I gathered are still under examination. Unlike the west side of the fiord, there are no characteristic sharp jagged peaks, except Ben Nevis, which forms quite a peak with its upturned strata of laminated sandstone dipping to the SW. I shall show you some views on the screen that I took from the summit of Ben Nevis, of the interior of Spitsbergen to the southward, showing

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great ranges of mountains with glaciers in the valleys, where the maps chart "*inland ice*." I fear "inland ice" is a term useful for covering our ignorance of the interior of Spitsbergen, but non-existent as far as I have been able to see and to record by photographs and sketches taken from the summit of several of the higher hills. In Recherche Bay and other places, where I have climbed hills and made inland excursions, I have found valleys with rivers where glaciers are mapped; and mountain ranges with glaciers, and sometimes even without glaciers, where "inland ice" is marked. Inland ice therefore on the charts may as a rule be read, "*This part of Spitsbergen is entirely unknown.*"

As far as I am able to judge, Red Bay has been greatly modified

RECHERCHE BAY—VIEW ACROSS THE VALLEY FROM NE. TO SW.; GOOSE POND IN FOREGROUND.

by a great glacier which once filled it up, flowing to the northward. The seven large glaciers including Smith glacier, Portier glacier, and Fuhrmeister glacier, were tributaries as well as Chauveau glacier at the south end. Grand Glacier was likely the main stream even in those days. The soundings seem to indicate this, as Captain Guissez obtained fifty fathoms at the inner end, and only twenty at the entrance. The land also appears to be more rounded off looking northward, and there are deposits of boulder clay near Point Bruce, the stones of which often form circles and hexagons in a very remarkable manner. Anybody would imagine this to be the case, even although they did not know what circumstantial evidence to look for. The whole lie of the land and of the ice at present seems to bear witness of a glacier having once run down this fiord.

The living mobility of glaciers is well seen in this fiord, for each

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glacier descending in its valley appears to be advancing with irresistible power. One can quite well imagine that he actually sees them creeping down like a river; but the ice suggests stupendous force which water does not. There are whirlpools and eddies indicated in places by stones which form spiral patterns on its surface, ripples too and yawning crevasses, or some mighty boulder being borne towards the sea. Mr. William Smith, the Prince's zoological and landscape artist, saw better than any of us the rapid demolition of the ice-face of glaciers, especially in the case of Grand Glacier. For three or four days consecutively he was making careful studies of the extensive ice-face of this glacier close to it at the foot of Ben Nevis. The crumbling away of the front some 80 or 100 feet high and over a mile long was continuous; and between the time he had finished one day's work and had begun another, there was hardly a single piece of the whole face of the glacier the same as on the previous day. On another occasion, while painting the face of a glacier, which now bears his name, he saw the calm water retreating before him; in another moment a great wave advanced which swept all his possessions away into deep water, but fortunately not himself. His easel, paint-box, brushes, pictures, and valuable sketch-book were gone before his very eyes before he had time to save them. A great fall of ice must have occurred at some distant glacier (for he heard no sound) which caused this wave, somewhat of the nature of a tidal wave. So great and rapid is the destruction of these mighty rivers of ice! An interesting piece of work done was the accurate survey of the ice-faces of some of these glaciers. If during this year and in future years a new survey is made, we shall be able to learn a good deal about the advance or retreat of some of these Spitzbergen glaciers. In Recherche Bay, East glacier has retreated 450 mètres from 1892 to 1899, while Fox glacier shows a slight retreat in its northern half and a retreat of 440 mètres on its southern half during the same period. Time will not allow me, otherwise I would endeavour to give you my reasons for believing, that a similar retreat of ice has taken place in other parts of Spitzbergen, that I have visited. I will try however, to indicate these points when I throw the pictures on the screen.

Some days after our release the Swedish Arc of Meridian Expedition steamer *Svenkshund*, in command of Captain Hamilton, came into Red Bay to afford what assistance she could, as she had seen our notice of distress at Pike's House, Dane's Island, where she happened to call. When we had stowed all the provisions of the encampment and had got the *Princesse Alice* into better trim, Captain Hamilton returned and accompanied us on a trial trip to Trurenberg Bay, the headquarters of the Swedish Expedition. Here he kindly supplied us with some coal (as we had thrown nearly all we had overboard), and this took us to Ice Fiord, where a coal ship was to meet us. We then proceeded to Recherche Bay with the coalship, and whilst coaling for about three days proceeded to explore and make collections. Then we left Belle Sound for Tromsö, but on account of bad weather, which we dared not face, not knowing how much damage had been done to the hull of the ship, we returned to Van Mijen's Bay. On the second day after, in finer weather, we left

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Spitsbergen and reached Tromsö in the beginning of September. Divers were sent down to examine the ship's bottom, and were required by Lloyd's agent to plug up two good-sized holes with wood and wooden sheathing. We arrived safely in Havre on the 12th of September, the day after the condemnation of Dreyfus by the Court Martial.

Time has not allowed me to enter into all the work which was done during these interesting cruises by the Prince of Monaco and his scientific staff. Zoology during 1899 did not occupy the chief place; but trawl, dredge, nasse, and tow-net were used several times off the Norwegian coasts, and in some of the fiords of Spitsbergen up to lat. 79° 57′ N. In Red Bay, Advent and Magdalena Bays, Smerenberg Sound,

DR. JÄDAREN. H.S.H. THE PRINCE OF MONACO.

SCIENTIFIC STAFFS OF MONACAN AND SWEDISH EXPEDITIONS.

Trurenberg, Recherche and Van Mijen's Bays collections of mammals, birds, fishes, and invertebrate forms as well as plants were collected. Dr. Portier, the physiologist, carried on a number of interesting researches on seals, birds, and other animals; whilst the bacteriologist, Dr. Chauveau, made a number of interesting observations in his department. He found the contents of the intestines of the seals, foxes, and birds he examined absolutely sterile, results which are contrary to those obtained by Dr. Levin of the *Antarctic*. Captain Guissez, with the co-operation of Captain Carr, Drs. Richard, Portier, and Chauveau, took 2400 soundings, measured 4200 angles, starting with a base 2370 mètres, besides taking observations for tides and magnetic declination. By ascending several of the higher peaks up to the height of 3000 feet I was able to take

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other angles which connect peaks 20 miles to the southward with those of Red Bay.

In the thorough survey of Red Bay hydrographically, biologically, and otherwise; in carrying on oceanographical researches round Spitsbergen, it must be acknowledged that His Highness the Prince of Monaco has rendered most valuable services not only to pure science but to navigation, and it is the sincere hope of his many admirers that he may long be spared to continue his labours in this direction. I take this opportunity of expressing my most grateful thanks to him for the opportunities he has afforded me for continuing my scientific researches in the Polar Regions during the past two years.

GEOGRAPHICAL NOTES.

AFRICA.

The British Central Africa Protectorate.—The report on the trade and general conditions of the Protectorate for the year ending March 31, 1900, was issued last month. The Commissioner states that trade has increased (amounting altogether to £250,000); the revenue has considerably exceeded the amount which was estimated; the value of imports has increased 50 per cent.; exports have been doubled; and the production of coffee is three times what it was the previous year. The cultivation of tobacco and chillies has been much extended. The African Transcontinental Telegraph Company has steadily extended its line to the north; it is now in course of construction up the east side of Tanganyika; the company has also run a branch line from Lake Nyasa to Fort Jameson, the headquarters of the Chartered Company in North-Eastern Rhodesia. Native operators are employed on these lines. The Admiralty is preparing a chart of Lake Nyasa, the work of Lieutenant E. L. Rhoades, who is obtaining systematic soundings throughout the lake, from which a bathymetrical chart will eventually be prepared. Game continues to increase in the elephant marsh reserve, but the expectation that elephants would return in numbers to their old haunt has been disappointed; this is probably due to the constant passage of steamers on the Shire river. Together with the increase of game in the reserve, there has also been a marked increase in the number of lions, which have become very troublesome in the neighbourhood of Chiromo. Handsome and substantial Government buildings, including a new court-house, judicial offices, collectorate, post-office, etc., have been erected in Blantyre. The officers of the Protectorate Administration carried out the definition of the Anglo-Portuguese boundary on the whole of the eastern, and a portion of the western, side of the Protectorate; a length of boundary extending to about 350 miles was defined, and an area of about 8000 square miles was mapped. The lower portion of the western side of the Protectorate, viz., the Zambesi-Shire watershed still remains to be defined. There has been a slight increase in the European population, but the Indian, or "Banyan" immigrants have multiplied more rapidly. The latter undertake various branches of small trade with the natives. The cultivation of rice on the shores of Lake Nyasa has progressed, and about 800 tons were placed on the local market; it is of good quality, but cannot be exported owing to the high freights. "The past year," says Mr. Sharpe, "has shown very conclusively that a railway from Chiromo to Blantyre,

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eventually to be extended from Blantyre to Lake Nyasa, is necessary for the welfare and advance of the Protectorate. At the present time almost the whole of the available labour-supply, which should be occupied in planting and other operations, is occupied in carrying loads from the navigable Shire river to Blantyre, the Shire highlands, and to the Upper Shire river. Transport work has so very largely increased that it is probable that during the current year the whole supply of labour will not be sufficient to cope with even the transport question. Natives prefer transport work to any other, as they can more quickly and easily earn money by this means. I consider that the British Central Africa Protectorate has now almost reached its limit of production and export, unless a railway is constructed from Chiromo to Blantyre. The Kondowe Industrial Institution, which is under the direction of Dr. Laws, has made great progress; large numbers of natives are apprenticed, and are learning useful trades, such as carpentry, blacksmith's work, telegraphy, mason's work, etc. The imports during the year 1899-1900 were, by Port Herald £3729; and by Chiromo £154,305; in all, £158,034.

The Volcanoes of Kivu.—Describing the Kivu country in the *Geographical Journal*, August 1900, Mr. Grogan compares the scenery to a "blend of Scotland, Japan, and the South Sea Islands." The lake has an extraordinarily broken coast-line; on the east coast two long arms run several miles inland, and thousands of lochs, islands, and creeks diversify its shores. The surrounding country is covered with innumerable small isolated hills, furnishing admirable pasture. At the north-east corner of the lake the hills stop, and the country slopes gradually from the lake-level to the base of the volcanoes, broken only by scattered dead volcanic cones still perfect in form. Of the six largest volcanoes, four are extinct and two active. Of the two western peaks, the higher, usually called Kirunga, was named Mount Götzen by Mr. Grogan; and the second, which has arisen since Count Götzen discovered Kivu, was named Mount Sharp, after Mr. Grogan's fellow-traveller. Mount Sharp was formed in the course of a terrific eruption which the natives describe as have occurred two years before Mr. Grogan's visit. The crater is several miles in extent; the main stream of lava flowed for thirty miles down the Ruchura valley. Huge lava blocks and vast quantities of ash were thrown up, and in some places are piled to a height of thirty feet on the top of the lava stream. The forest in the valley was swallowed up, and the higher forest was blown down by the winds which accompanied the eruption. The width of the lava stream, at one point, was fifteen miles. Mr. Grogan ascertained that the peak named Mfumbiro, which is conspicuously marked on most maps, and was accepted by Britain from the Germans as an offset to Kilimanjaro, in the definition of the boundary between British and German East Africa, has no existence.

ASIA.

Central Asia and India.—At a meeting of the Indian Section of the Royal Society of Arts on February 8, 1900, a paper was read on railway communication with India by Mr. J. M. Maclean, M.P., in which he discussed the railway schemes of Russia in Central Asia with special reference to a linking up of the Russian and Indian systems by a line from Orenburg to Samarkand. "I well remember," he said, "that this scheme was foreshadowed by M. de Lesseps, the creator of the Suez Canal. He made a journey to Bombay for the purpose of bringing it before the Indian Government, and proposed to return home through Afghanistan and Central Asia to Orenburg, so that he might examine for himself the practicability

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of the route. Unfortunately the Afghan War broke out at that time, and M. de Lesseps abandoned his enterprise. But what was then a dream is now a practical possibility." He has in view a line of communication through the passes of the Hindu Kush, say from Kabul to Mazar-i-Sharif and Kilif. "This route appears to me," he said, "to possess unquestionable advantages over any other that can be named. Now that the Transcaspian railway through Russian territory has been opened as far as Samarkand, and a branch made as far as Kushk, in close proximity to Herat, many people favour the completion of this line of communication as far as Chaman, below Kandahar, which is the terminus of the Indian railway system. The line from Herat to Kandahar, a distance not exceeding 500 miles, runs through a comparatively easy country, and could be built cheaply and expeditiously. But this line would debouch into India at its extreme western limit, and would be complicated by the break of the Caspian Sea, across which goods and passengers must be conveyed by steamer. What is wanted is unbroken land communication from Calais to Calcutta, and this is supplied by a line through Orenburg, which avoids both the Caspian and the Sea of Aral, and runs for the greater part of the way through a region well known in ancient times for its fruitfulness."

In the discussion that followed Sir Thomas Holdich said he did not think it possible or necessary to carry any line direct through the mountainous country between Tashkend and Peshawar, and he put aside any railway line along the southern coast of Persia. He had been occupied in surveying the country between Quetta and Herat, which was exceedingly easy for the alignment of a railway. There were large open sweeps of soft sand soil, covered with scrub, exceedingly well adapted for sheep, varied by wide spaces of hard gravel, plentifully besprinkled with green oases and big villages, and there was nothing in the shape of a serious mountain range to encounter. It had been said that a line between Quetta and Herat would never pay, but if so, it would not be for want of inhabited places through which it would pass. There was the well-known old town of Farra, which had been a centre of trade through all history; north of it was another, Sabzavar, which was the centre of a great agricultural district, and there were many other villages and towns, all of which were centres of local industry, and some carried on a considerable business in carpet-making. Notwithstanding the difficulty of crossing the Caspian, he still believes in the junction between Herat and Quetta. He did not underrate the objection raised by military authorities to the proposed line, *i.e.* that it seemed to give Russia some sort of opening to India, but they had perhaps overlooked the difficulty which would arise from the break of gauge, and overrated the difficulty we might have in holding that part of the country by sending more troops there. As things stood at present there was no chance of making that railway, because the Amir would never agree to it. When he did agree we should have a right of entry into Afghanistan, and to a certain extent the command of Afghan troops. Mr. G. H. Skrine said it was not in the contemplation of the Russian authorities to connect Orenburg and Samarkand. To do so would involve a considerable detour, and crossing 800 miles of the most frightful desert in the world. The cost would be at least £10,000,000, and there would be very little intermediate traffic. A junction between Tashkend and Ishim or Omsk railways, as favoured by Prince Hilkoff, would be preferable, but the line he advocated was by way of Calais, Vienna, Rustov, Petrovsk, Baku, across the Caspian to Krasnovodsk, and thence to Merv, Kushk, Chaman, and Kandahar. Mr. J. M. Perry recommended the survey of a line with levels from Baghdad to Basra. Reference was also made to the schemes of Mr. C. E. D. Black and Colonel Frazer for a railway from Egypt to the head of the Persian Gulf.—*Journal of the Society of Arts*, xlviii. pp. 273-284.

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Central Asian Railway.—It has been announced that the Transcaspian railway is now to be known officially as the Central Asian railway. It was also announced from Odessa on the 9th of April last that, as regards connection with Europe, two alternative routes had been suggested, the one from Orenburg to Tashkend, and the other from Alexandroff-Hai to Charjui on the Amu Darya. The former named is 1073 versts longer than the latter, and for this reason chiefly the Alexandroff-Hai and Charjui connection has been recommended.

Baluchistan and the Nushki Route.—From Persia to India through Baluchistan there are three possible routes from Sistan. The first is *vid* Nushki; the second leads southward *vid* the Mashkel river, and branches off into the fertile districts of Panjgur and Kolwa, and thence proceeds by way of Baila to Karachi; the third follows the same course in its early stages, then diverges more to the south into Kej, following that valley and, running parallel with the coast through Baila, leads to Karachi. The important fact has been pointed out that some of the finest camel-grazing in Baluchistan is to be found in the plain known as the Dasht, south of Panjgur, and more or less throughout Makran. The southern routes are protected to the north by the Kharan desert. The Nushki route is through an arid desert. Kej and Panjgur are comparatively fertile and well-watered districts. It is the Nushki route which the Indian Government has been opening up and developing since the end of 1896. From Quetta it passes through Nushki, Chah Amir, Kuh-i-Malik Siya, Nasratabad or Nasirabad in Sistan, Birjand, Kann, Turbat-i-Haidari to Mashhad. It is some 1092 miles in length, compared with 966 miles for the caravan highway from Bandar Abbas by way of Kirman and Birjand to Mashhad.

Besides this route to Mashhad, a through trade route has been opened up between Nushki and Kirman, which are to be connected by a line of telegraph through Ladis and Rigan.

Erzerum and the Proposed Railways.—Mr. Consul Lamb in his Report on the Trade of the Consular District of Erzerum for the year 1899 says, that rumours have been current there with regard to Russian projects of railroad construction in the province. Although these have been semi-officially denied, they have, nevertheless, not failed to create a certain amount of excitement in the public mind. The lines at present spoken of are:—(1) An extension of the recently opened Tiflis-Kars railway *vid* Sari-Kamish, Kara-Surgan, and the Pasin Plain to Erzerum, a distance of 160 miles; and (2) a line from Tirabzun to Erzerum, the distance between which places by the existing caravan route is about 180 miles. "The latter of these two projects," he says, "if carried into execution, would be of undoubted benefit to the country, for not only would it reduce the time occupied by goods in transit between this city and the coast from eleven or twelve days to less than as many hours, reducing freight about £5 per ton, but it would also, sooner or later, inevitably result in the at least partial development of the great mineral wealth that indisputably lies dormant in these hills. The importance of the former scheme would, in my opinion, be political rather than commercial or economical. It would facilitate, without materially increasing, the exchange of Bakou petroleum for agricultural produce, but it would not in all probability result in any considerable development of Russian trade with this region, beyond, perhaps, the substitution, under the system of drawbacks, of Russian sugar for the article now supplied by France.

"I doubt, however, if there is any immediate probability of either project being carried into execution, the extension of the existing line as far as Sari-Kamish, at

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the (northern) fort of the Soghanli Dagh, being all that seems at present in contemplation."—*Consular Reports*, Annual Series, No. 2477, pp. 5-6.

Lake Van.—Mr. Maunsell, H.B.M.'s Vice-Consul at Van, says in his Report for 1899 that the trade with Aleppo (Halab) has improved, and that the route from Alexandretta (Iskandarun) is coming more into favour, as the landing charges are less than on that through Constantinople and Trebizond (Tirabzun). He announces that the contract for a steamer, constructed in sections, has been given to Messrs. Yarrow of London. "This excellent result," he says, "is mainly due to the interest which His Majesty the Sultan has shown in Tahir Pasha's projects, while the necessary funds are supplied from his private treasury. The introduction of steamers will greatly shorten the transit to Bitlis, and also to Erzerum, as the distance to Akhlat, at the north-west corner of the lake, some fifty-five miles, can be covered by a steamer in about four hours, and from there a direct road leads to Erzerum. This would result in a saving of at least three days on the present route, which has to go round the head of the long north-east arm of the lake. Indirectly, also, the advent of steamers will result in the opening and working of the various deposits of coal and lignite known to exist in the province."—*Ibid.* pp. 7-8.

Samsun to Baghdad.—Mr. Milo A. Jewett, the U.S. Consul at Sivas, discusses in his report for last year the German railways and schemes in Turkey in Asia. He insists on the great prospective importance of the prolongation of the Anatolian system of railways which will unite the Persian Gulf with Europe, form a rapid transit to and from the East, open up large tracts of agricultural country, and pave the way for German commercial supremacy in Asia Minor and Mesopotamia. He foresees that Germany, with preferential rates for goods on German lines, will be able to control the chief markets of Asia Minor and invade the East. The two great distributing points, Constantinople and Smyrna, have both come within the control of the Germans since the Anatolian railway was extended from Eski-shahr to Koniya, and thus German goods may enter the interior of Asia Minor and the great valley of the Tigris and Euphrates at a decided advantage. He then proceeds to say that he sees but one scheme of competition left for the United States in Mesopotamia and Southern Anatolia. This is to build the proposed line of railway from Samsun or Sinub to Sivas, Diyarbakr, and Baghdad, which will open up a country vastly superior in agricultural products and give more local traffic than the German line from Koniya to Baghdad, which must traverse a barren and sparsely inhabited land.

This line was proposed in England by Sir M. Stephenson; it was advocated by the Stafford House Committee, and in 1871-2 the Select Committee of the House of Commons recognised that there might be reason to prefer the route by way of the Tigris, and in that event a branch line would be built from Mosul, Mardin, or Diyarbakr to the Syrian coast, and another branch would be built to the Black Sea, running from Mardin by way of Diyarbakr, Malatiya, Sivas, and Tokat to Samsun.

Haifa Railway.—In the Consular Report on the trade of Bairut and the coast of Syria for 1899, it is said that the work of construction of the Haifa-Damascus railway was resumed at the end of 1898, and has been carried on steadily, though slowly. The earthworks and waterways are now practically completed as far as the 57th kil. from Haifa (*i.e.* up to the vicinity of Baisan), with the exception of a length of about 5 kil. near Solam (40 to 45 kil.), which are at present under

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construction. It has been found impossible to continue the work beyond the 57 kil. from Haifa, as permission has been absolutely refused to the contractors—the Thames Ironworks, Limited, of London—to commence operations in the Sultan's farms at Baisan. The differences between the Company and the Ottoman Government, with regard to the concession, have not yet been satisfactorily arranged.

Afghanistan: The Key to India.—Mr. Archibald Colquhoun, in a paper read before the East India Association on June 12, urged the importance of carrying forward the British line of defence against Russia into Afghanistan. He pointed out that little had been done except to protect the mouths of the passes opening on to the Indus plains—a most unsafe plan of defence, because, if Afghanistan be allowed to fall entirely into the hands of Russia, India will have as her neighbour a strong and possibly hostile western power instead of a weak and ostensibly friendly one: and also because a passive defence leaves to Russia an open road to the Persian Gulf and to Baluchistan. In order properly to defend the Indian Empire it was necessary to defend Afghanistan, the bulwark of India. The true line of defence for India was to go forward, to occupy Kabul, Kandahar, and Ghazni, and to establish outposts on the Hindu Kush, reserving the right to make a further advance beyond the Halmand towards Sistan, and elsewhere if necessary. Communications should be opened up throughout Afghanistan, and trade with the natives should be developed. Fortified posts at desirable points should be established, supported by magazines and depots. Such a campaign required, in order to be successful, the extension of railways—for instance, a railway from Peshawar to Kabul, and the extension of the Indus-Bolan line by way of Nushki and south of the Halmand river (through Baluchistan) to Sistan, with branch lines to Kandahar and Kabul; also a direct line from Chaman to Kandahar, and eventually a southern extension from Sistan to the Persian Gulf. "The time has gone by," said Mr. Colquhoun, "for buffer states in Asia, in China, in Afghanistan, Baluchistan, or Persia. Russia has long since made up her mind on this point, and where we do not go she certainly will. The effective and immediate introduction into these territories of British capital, British railways, British influence, is absolutely essential if we do not wish to find our rival there before us."

Indian Famine: Suggested Precautions.—Several famines have occurred since the time when the Government definitely adopted the policy of doing all that is possible to prevent loss of life through the failure of the crops. Economical and efficient methods of relief have been devised, and the necessary funds have been provided. But the number of the applicants for relief continues to increase; in 1897 there were many more than during former famines, but the famine of the present year has reduced even a greater number to destitution. Mr. R. Carstairs, I.C.S., suggests certain precautionary measures in the *Imperial and Asiatic Quarterly Review*, July 1900. He points out that improvement of communications, and provision of relief work, with coin-payments in wages and charity sufficient to enable those in distress to buy food, constitute the policy at present adopted. Government does not move grain about the country, or fix prices, but expects the food to be carried by private trade to the point at which it is required. These measures answer their purpose; but they do so greatly at the expense of the solvent areas. Grain is the currency of the Indian agricultural population, and when the Government steps in with relief paid in coin, thus offering famine prices, in cash, for unlimited quantities of grain, it comes into competition with the demand of the population of areas where the crops have not failed. The traders,

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who hold the stock of grain, carry off to the famine area grain that is wanted for local consumption, and will not sell to local consumers except at famine prices. Mr. Carstairs insists on the importance of checking population within the famine areas. "This," he says, "can best be done by imposing on the inhabitants of areas that have had to take help from the State for famine relief, a special tax, whose proceeds are to be devoted to the repayment of the sums so taken. The double effect of this tax is to force on the inhabitants in good years the memory of the bad years, and to prevent them from presuming on temporary plenty; and to bring pressure on the surplus population that they may emigrate. Such a tax, to be efficient, must be harsh. There is a distinct tendency, which is encouraged by the Government relief policy, for the poor recklessly to increase their numbers in good times, and trust to State relief when bad times come." It is also regarded as necessary that the present fluctuation in the grain supply should be checked. This may be done in two ways: by discouraging the cultivation of crops known to be precarious, and by the formation of a grain reserve. Mr. Carstairs describes a "grain bank" which he established with great success. During times of scarcity the bank advanced a quantity of grain to various tenants, on condition that for every maund (about 80 lbs.) advanced, they should return after harvest a maund and a half. This, it seems, is the customary rate charged in ordinary times by private creditors. Distribution and collection proceeded year by year; in five years the bank held in its granaries a large reserve of grain; and in the famine year only 25 instead of 50 per cent. interest was charged. There were practically no debts and no lawsuits.

GENERAL.

Kite and Balloon.—Mr. A. Lawrence Rotch, of the Blue Hill Meteorological Observatory, communicates to *Science*, August 3, 1900, that on July 19th, by means of six kites attached at intervals to four and three-quarter miles of steel wire, the meteorograph was lifted 15,170 feet above Blue Hill, or 15,800 feet above the neighbouring ocean. At the time that the temperature was 78° near the ground, it was about 30° at the highest point reached, the air being very dry and blowing from the north-west with a velocity of twenty-six miles per hour. The altitude reached in this flight probably exceeds the greatest height at which meteorological observations have been made with a balloon in America. The highest observations that have been published were made by the late Professor Hazen of the Weather Bureau in an ascent from St. Louis, June 17, 1887, to a height of 15,400 feet.

North Polar Expeditions of the Present Year.—After an interval of ten years the North-East Passage is being again attempted by Baron v. Toll, with an expedition provided for three and a half years; he expects to spend two winters in the ice. The Duke of the Abruzzi, who left for Franz Josef Land last year, and wintered there, will probably be heard of this summer, as a Norwegian vessel has been sent north to communicate with his *Stella Polare*. The Swedish expedition under Kolthoff's leadership set out at the end of June for Bear Island; they did not land, but proceeded thence to Spitsbergen; after finishing their work there, they will go to East Greenland. The vessel is fitted out for eighteen months, but Kolthoff intends to return in September if possible. A Danish expedition under Lieut. Amdrup, who explored the southern portion of the east coast of Greenland in 1898 and the following year, has returned to the same region. Amdrup will land at Scoresby Sound with a few companions, while the ship, under the leader-

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ship of Herr Hartz the palæontologist, will undertake the examination of the region north of the Sound. Peary, who went to Smith Sound in 1898, and intends if possible to reach the North Pole, has established, with the assistance of the Eskimo, a station on one of the most northerly points of Greenland, where he may remain in the event of the failure of his attempt. Sverdrup is carrying out his scheme of following the north coast of Greenland to the east coast where a large extent of coast-line still awaits exploration. The condition of the ice makes it doubtful whether he will succeed in passing the north coast with the *Fram*, but he has a large number of dogs which he will use for sledge journeys. There are therefore large expeditions in the Arctic regions this summer. A part of the Swedish and Russian expedition, charged with the measurement of degrees, also wintered in Spitsbergen ; the party is also undertaking other scientific work, and will return in autumn. Another Russian expedition, under Knipovich, will explore Spitsbergen this summer. This is of interest in connection with the attention now being paid by the St. Petersburg press to this polar country, which is already regarded by the Russians as their territory. Since the Russian Government has spent large sums on a harbour quite near the Norwegian frontier, it is naturally anxious that access to the Atlantic ocean should not be threatened by the foreign occupation of Bear Island or Spitsbergen. There is also coal in Spitsbergen, though its quality has not been defined ; in Bear Island the coal measures are of great extent, but the nature of the coast makes its exploitation very difficult.—*Geogr. Zeit.*, August 1900.

University of Oxford : School of Geography.—The Oxford School of Geography occupies the upper floor of the Old Ashmolean Building in Broad Street, where a lecture-room and a laboratory have been fitted with the necessary appliances. Admission is not confined to members of the University of Oxford, but all applicants must give satisfactory evidence of sufficient general education to profit by the teaching. Both men and women are admissible.

Courses of Study.—(*a*) A course of instruction in the subjects required for the University Diploma in Geography begins in October and extends over one academic year. Weekly lectures are delivered by all the members of the staff, and practical instruction is given during the mornings of four days in each week. (*b*) Special instruction in position-finding, surveying, and cartography may be arranged for on application to the Reader in Geography. (*c*) Courses of lectures are, from time to time, delivered on geographical subjects, which are intended for certain of the Honour Schools of the University. Notice of such courses is given in the *University Gazette* and in the Terminal Schedules of the Boards of Faculties.

Diploma.—The Diploma in Geography of the University of Oxford will be awarded after examination, theoretical and practical, to such students of the School as shall have followed a complete course of study for one academic year, and shall have given evidence of a good general education. The scope of the examination is indicated by the following syllabus :—

The figure of the Earth and the determination of positions on its surface. The principles of surveying and of mapping. Map projections on the plane, the cylinder, and the cone, and their commoner modifications. The reading, reduction, and generalisation of maps, and the representation of climatic and statistical data. The methods of meteorological and hypsometrical observation.

The configuration of the continents and of the bed of the ocean. The characteristics, history, and distribution of the chief land forms, of the several types of mountain-systems, river courses and river basins, and of the coastal

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belt. The cartographical analysis of the forms, structures, and activities of the physical regions of the world.

The distribution of solar energy on the rotating Earth and the resulting circulations of air and water. The modifying effects of the distribution of land and water. The climatic provinces of the Earth.

The physical conditions of the oceanic areas and the methods of observing and representing them.

The chief generalisations regarding the distribution of animals and plants.

The geographical distribution of men according to number, race, and economic and political condition. The influence of physical features in determining the position of settlements and lines of communication.

The outlines of historical geography considered in relation to the influence of physical features.

The history of geographical ideas. The outlines of the history of discovery.

ARRANGEMENTS FOR MICHAELMAS TERM, 1900.—The Reader in Geography (Mr. Mackinder) will lecture weekly on "The Historical Geography of the British Islands," on Wednesdays at 12 noon, commencing Wednesday, October 17.

The Reader will also lecture weekly on "The Development of Geographical Ideas," on Fridays at 12 noon, commencing Friday, October 19.

The Lecturer on Physical Geography (Mr. Dickson) will lecture weekly on "The Atmospheric Circulation," on Fridays at 10 A.M., commencing Friday, October 19.

The Assistant to the Reader (Mr. Herbertson) will lecture weekly on "The Geographical Cycle," on Wednesdays at 10 A.M., commencing Wednesday, October 17.

The Lecturer on Ancient Geography (Mr. Grundy) will lecture weekly on the "Geographical Development of the Roman Empire," on Saturdays at 11 A.M., commencing Saturday, October 20.

Practical Instruction in Geography will be given on Mondays, Tuesdays, Thursdays, and Saturdays from 10 A.M. to 1 P.M. The Laboratory will also be open on Tuesdays, Wednesdays, and Fridays from 4 to 6 P.M.

NEW BOOKS.

Le Tour D'Asie, ij. L'Empire Du Milieu. By MARCEL MONNIER. Paris: Librairie Plon. Pp. 373. 1899.

M. Marcel begins his book with a prelude on Japan, revisited shortly after the war with China. He is mildly sarcastic with the globe-trotter's usual descriptions of a "coquet Japon," of a "Japon-joujou," and accordingly proceeds to enlarge upon the immensity of the country. Yet even he, in his account of a long journey, describes among the wayfarers two girls "fumant leurs pipettes." M. Marcel warns against outbursts of savagery on the part of the gentle Jap, and against their dislike of foreigners. "L'Européen, voilà l'ennemi!" "Ces Asiatiques ont horreur de l'Européen!" Yet in spite of it all they are charming, and their country is "le sourire de l'Asie." The main part of the work is taken up by M. Marcel's travels in China, beginning with Tientsin and its 800,000 inhabitants. Of Pekin he says the people are gentle as compared with the populations of Canton or Shanghai; small children might laughingly call him foreign devil, but he attracted less attention than would a Chinaman in a European town. In this respect it is easy to be wise after the event, but the value of M. Marcel's observations may be doubted

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when we read his description of the soldiery, disarmed after the war of their Mausers and Martinis to be rearmed with longbow and crossbow, their artillery consisting of matchlocks resting on the shoulder of an artilleryman. Again and again he guards himself by such phrases as "ici plus que partout ailleurs, l'âme Asiatique est impénétrable." So that, after a chapter devoted to the insuccess of European agents to push their goods in Pekin, one is not surprised to find paradoxical generalisations. China, he says, is apparently untouched by external influences, but China has always accepted foreign domination of Mongol Tartars. Of whom next?—the White Czar? M. Marcel does not think China an infinite market for European goods. The population is too poor to buy luxuries. The book is illustrated by photographs of scenery and inhabitants. M. Marcel journeyed up the Yangtse and down the Red River to Tonkin, and promises an account of a journey across Central Asia in a succeeding volume.

A Short History of the Expansion of the British Empire, 1500-1870. By W. H. Woodward. Cambridge: The University Press, 1899.

"This History is not a 'Manual,' *i.e.* a digest of the general body of facts relative to colonial history. Events have been dwelt upon, or passed over, as they serve, or do not serve, to illustrate the broad underlying principles which from time to time governed British expansion." "The right kind of text-book should aim at something beyond storing the mind with facts, viz., at stimulating the reader to further inquiry, and at guiding him in the classification of his material, and in framing conclusions about it." These quotations from the preface well portray the characteristics of this book—a book strongly to be recommended, inasmuch as it really answers to the high ideal here set out. Beginning the story at the period of the world's geographical expansion, the discovery of the New World, the writer traces the expansion of our empire, showing what motive prevailed, and in what part of the world expansion was carried out, at successive periods, referring, throughout, events and results to their underlying and preceding causes. It is this constant reference to the philosophy of colonisation that gives the book at once its charm and its value. Not only students, for whom specially the book is prepared, but the great body of the educated uninformed may gain much necessary and highly desirable knowledge from its perusal. "No civilised country treats its national history with such scant regard as Englishmen" [*sic*], hence the need and value of such a book as this. A careful revisal might, however, remove numerous small inaccuracies and infelicities of diction, of both of which examples may be found in the last quotation we have made. These suggest that the author, though obviously complete master of his subject, has written his book somewhat hastily.

In Dwarf-Land and Cannibal Country. A Record of Travel and Discovery in Central Africa. By A. B. Lloyd, with Introduction by the Right Hon. Sir John H. Kennaway, Bart., M.P. 146 Illustrations and Maps. London: T. Fisher Unwin, 1900. Pp. xxiv + 385. *Price* 6*s*.

In the January number of the *Magazine* we gave a review of the dearer edition of Mr. Lloyd's book. We need here only mention that in this handier and much cheaper form the book deserves a ready and speedy sale.

Notes sur l'Inde, with 30 Illustrations. Prince Bojidar Karageorgevitch. Paris, n.d.

Prince Bojidar Karageorgevitch has no relish for hard facts and details of government, and so, in preparing for his visit to India, he shunned statistical and

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progress statements, and took as a guide *La Conquête du Paradis de Judith Gautier*, and a sketch of Hindu literature by Jean Lahor. With this preparation he was, of course, prepared to see India with other eyes than those that serve the ordinary tourist, and he has given the reader the results in *Notes sur l'Inde*. They read easily, but are not particularly accurate. The thirty illustrations are good.

The Civilisation of India. By ROMESH C. DUTT. (The Temple Primers.) 146 pp., 16mo.

This handy little book is really a primer, as it is described. In a very compact form it supplies a clear outline of the history of India, civil and religious, from the earliest Vedic age till 1849. The whole is divided into twelve short chapters, each containing a condensed account of a period, illustrated by extracts from authoritative words. Without guaranteeing the accuracy of every statement, we can point to no work containing, in so short a compass, so instructive an introduction to the history of India. The illustrations are poor.

B. Bradshaw's Dictionary of Bathing-Places, Climatic Health-Resorts, Mineral Waters, Sea Baths, and Hydropathic Establishments. With Maps and Plans. London: Kegan Paul, Trench, Trübner and Co., Ltd., 1900. Pp. xl + 374. *Price* 2*s.* 6*d.*

This dictionary of health-resorts should be opportune at this season. It is specially intended for the invalid, who, after a study of the volume, should find no difficulty in deciding upon a place suited to his *maladie*. The names of doctors, hotels, and the quickest routes by rail, boats, and carriages, besides other useful hints, are given.

The Natal Almanac, Directory, and Yearly Register, 1900. Pietermaritzburg: P. Davis and Sons. Pp. xxx + 928 + 371.

Owing to the war in South Africa the publication of this book was delayed, but the publishers have lost no time in issuing it after the necessary information had been received. It is replete with postal, telegraphic, railway, and other useful information, which increases its value as a handbook indispensable for reference. In the "Notes on Natal" the war is, of course, only casually mentioned, and in this reference a tribute is paid to the brave colonists who have fallen for their country.

Maryland Weather Service. Volume I. Baltimore: The Johns Hopkins Press, 1899.

From the preface we learn that Part I. (*Introduction*) is devoted mainly to a discussion of the plan of operation of the Maryland Weather Service, together with a recital of the facts connected with its organisation. Part II. (*Physiography of Maryland*) embraces a general statement regarding the more important physiographic features of the State. To this is appended a detailed discussion of stream development in the Piedmont Plateau. The report on the *Meteorology of Maryland* comprises Part III. A special feature of the volume is the excellence of the illustrations. They are printed in a variety of tints, and show advantageously the natural features of the country. The charts show the monthly and seasonal variations in the temperature, also the amount of precipitation; maps and diagrams are also included.

It is intended to publish in the near future a full account of the climatic features of Maryland, in which the physiography, the meteorology, the hydrography, the medical climatology, the agricultural soils, the forestry, the crop conditions, and the flora and fauna of the State will be considered.

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

ADDRESS TO THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION, 1900.

By Sir GEORGE S. ROBERTSON, K.C.S.I., President of the Section.

WHEN the British Association for the Advancement of Science honoured me with an invitation to preside over this Section, I accepted the distinction, thoughtfully and with sincere gratification. The selection as your President at Bradford, this great and interesting centre of commercial energy, of a student of political movements who was also deeply interested in the science of geography, seemed to point suggestively to a particular branch of our subject as appropriate for an opening address. This consideration, and, to my thinking, the fitness of the occasion, led me to believe that the British Empire itself was a very proper subject for such reflections as could be compressed within the limits of an inaugural presidential address. Many of my predecessors have eloquently and wisely dealt with various topics of admitted geographical rectitude—with geography in its more strictly scientific study, with its nature and its purview, with its recent progress, and with the all-important question of how it could be best taught methodically, and how most profitably it might be studied. In dealing with the important practical application of our science to the facts of national life—political geography—I feel that perhaps a word of explanation is necessary. Pure geography with its placid aloofness and its far-stretching outlook, combined sometimes with a too rigid devotion to the facts and conclusions of strict geographical research, is apt to incline many scientific minds to an admirable quiet-eyed cosmopolitanism—the cosmopolitanism of the cloistered college or the lecture theatre. It perhaps also at times has a tendency to create in purely academic students a feeling of half disdain or of amicable irritability against those who love the science for

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its political and social suggestiveness and elucidations. Thus there is a possible danger that geographers of high intellectual calibre, with enthusiasms entirely scholarly, may come to underrate nationality and to look upon the world and mankind as the units, and upon people and confederacies and amalgamations merely as specific instances of the general type. We know that geography is often looked upon as the science of foreign countries more especially. Such mental confusion is undoubtedly less common than it was, yet it still influences, unconsciously, the minds of many people. It is well not to forget this curious fact, and to point out, as if it required emphasising, that there is nothing foreign to geographical thought in the association of geography and patriotism, and that the home country is worthy of careful study, particularly when, as with us, our home country is not Yorkshire, nor England, nor the United Kingdom, but the whole British Empire. That is my justification and my apology for taking Political Geography and the British Empire as my subject, if justification and apology seem to any one to be necessary. To the generous hearts of our distinguished foreign visitors who honour us quite as much as they delight us by their presence, I am sure of my appeal. Every true man loves his own country the best in the world. That beautifying love of country does not require him to be ignorant of or to hate other countries. The community of the civilised nations, no longer to be described as Christendom even, for Japan has been received into it, is a mighty fact in geography no less than in politics. To love mankind one must begin by loving individuals; before attaining to true cosmopolitanism one must first be patriotic.

Now, besides dealing with the topography of the globe, geography considers also the collective distribution of all animal, vegetable, and mineral productions which are found upon its surface. The aspect of the science which deals with man's environment, and with those influences which mould his national character and compel his social as well as his political organisation, is profoundly interesting intrinsically and of enormous practical usefulness when rightly applied. Given the minute topography of a country, a complete description of its surface features, its rivers, mountains, plains, and boundaries, a full account of its vegetable and mineral resources, a knowledge of its climatic variations, we have at once disclosed to us the scene where we may study with something like clearness man's procession through the ages. Many of the secrets of human action in the past are explained by the land-forms of the globe, while existing social conditions and social organisations can often thereby be intelligently examined and understood. Persistent national characteristics are often easy to explain from such considerations. For instance, the doggedness of the Dutch river-population, caused very greatly by a perpetual struggle against the sea, or the commercial carrier-instinct of the Norwegians, those northern folk born in a country which is all sea-coast of countless indentations. Having few products to barter, the Norwegians hire themselves to transport the merchandise of other peoples. We British also were obviously predestined to isolation and insularity, when perhaps in the human period the Thames ceased to be a tributary of the Rhine. Our Irish fellow-

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countrymen were similarly fated for all time to lead a separate, special, and national life apart from our own, when at a still earlier period, geologically, the Irish Channel was formed.

Such large-scale facts are not to be overlooked; there are others, however, of varying degrees of prominence. Some merely require to be interpreted thoughtfully, while others, after diligent study, may still remain dubious and matter for speculation. Geography is the true basis of historical investigation and the elucidation of contemporary movements. At the present time great social and political changes are occurring throughout the world—in Europe, Asia, Africa, and America, and in the islands of the great seas. These changes are absolutely dependent upon the physical peculiarities of the different lands acting upon generations of men during a prolonged period of time. As a consequence of certain soils, geographical characteristics, and climates, we notice how harsh surroundings have disciplined some races to hardiness and strenuous industry, accompanied by keen commercial activity, which is itself both a result of increasing population and the cause of still greater overcrowding. Then we see other people at first sight more happily circumstanced. With them the struggle to live is less ferocious, their food is found with little toil. But we perceive that the outcome of generations of Nature's favouritism has been to leave them less forceful and less ingenious in the never-ending warfare of existence. By comparison they grow feeble of defence against the hungrier nations, ravenous for provender. Man for ever preys upon his own kind, and an easy life in bland surroundings induces a flabbiness which is powerless against the iron training of harsh latitudes, or against the fierce energy and the virile strength produced by hereditary wrestling with unkindly ground.

The discovery of America and Vasco da Gama's voyage round the Cape originated movements and brought into play those subtle influences of foreign lands upon alien sojourners, and through them upon their distant kindred, which alter the course of history and modify national manners and perhaps national characteristics also. The colonisation of territories in the temperate zone by European Governments, separated by vast ocean-spaces from their offshoots, has given origin to new and distinct nations different from the parent stock in modes of thought and in ways of life—a result due mainly, no doubt, to local physical conditions, but in part also, if only in part, to detachment, to complete and actual severance from the mother-country. This brings us to that most interesting and important topic, geographically speaking, of distance, an aspect of our science which is of the utmost concern to traders and to statesmen; indeed, an eminent German geographer defines geography as the Science of Distances. To this subject of Distance I wish in particular to direct your attention, and especially to its bearings upon the British Empire.

The British Empire is equal in size to four Europes, while its population approximates four hundred millions. Although that may seem a somewhat grandiloquent method of description, it is a fairly accurate statement of fact. Still more interesting to us is another truth—that outside of these islands we have some ten millions of white-skinned English-speaking fellow-subjects. These islands are scarcely more than

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one-hundredth part of the whole Empire, although we count as four-fifths of its white population; of the total number of the Queen's subjects we are, however, no more than a tenth.

British Empire is somewhat of a misnomer, just as the North American and Australian Colonies were never colonies at all in the classical sense of the word. For the colonies are not independent of the mother-country. An empire again really means a number of subject peoples brought together, and at first held together, by force. India is an empire, for instance. Some new title or phrase would have to be invented to describe accurately all the possessions of the British Crown from the Government of India through all possible grades of more or less direct control until we come to some colony with representative institutions, and thence to the great commonwealths with responsible legislators and responsible cabinets. Happily, however, there is no need now for any novel designation. The style *British Empire* has become in time of stress a rallying cry for all the Queen's subjects, and the term has been sanctified by the noble, eager devotion shown to her Majesty, both as a beloved and venerated constitutional sovereign, and as the common bond of unity between those great self-governing daughter-nations which we in the past were accustomed to speak of as "our colonies." Consequently, *British Empire* has henceforward a clearly defined, a distinct, a national significance, just as Imperialism has a special and peculiar meaning to all of us. We understand by *British Empire* and by *British Imperialism* a confederacy of many lands under the rule of her Britannic Majesty. This confederacy is dominated by white peoples—Anglo-Saxons, Celts, French-Canadians, and others—knit together in most instances by the ties of blood relationship, but with equal if not greater closeness by common interests, an identical civilisation, and a love of liberty, in addition to that dignified but enthusiastic acceptance, already referred to, of the constitutional sovereignty of the same Queen. We may hope that generous democratic expansiveness and social assimilation will also in time detain willingly within the limits of this British confederacy of white peoples those other Christians and distant kinsfolk of ours in South Africa who are at present so bitterly antagonistic.

Ruled and controlled under liberal ideals by the centre of authority there are, in addition, the great subject-territories whose non-Christian population are less advanced in moral and material progress. They exhibit indeed every degree of backwardness, from the barbarism of the savagest tribesman to the intellectual but archaic civilisation of ancient Asiatic nationalities.

Concerning the British Empire, and comparing it with other empires, ancient, recent, or now existing, its two most remarkable features are its prodigious and long-continued growth and the persistency of its power. It cannot to all seeming grow much larger, from lack of expansive possibility. But it is unprofitable to predict. Every step which has been taken in the way of extension, particularly of late years, has been against the wishes and in almost passionate opposition to the views of large sections of the people. Yet the process of enlargement has gone on continually, being often in actual despite of a Government, whose

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members find themselves powerless to prevent absorptions and concretions which they would gladly avoid. Objections to this perpetual growth of empire in territory, and to the resulting responsibility which we not altogether willingly accept, are unanswerable theoretically. The too heavy and continually increasing strain upon our military resources every one can appreciate. The limit in power of the strongest navy in the world is at least as obvious as the vital necessity that our Navy be largely and ungrudgingly strengthened. Naturally the cry of cautious patriotic men is the same now that it has always been—"Consolidate before you step farther." In India, owing to conscientious and strenuous opposition to every suggestion of expansion and to the almost violent form which that opposition often took, our progress has been on the whole slow and comparatively safe. We have (I, of course, avoid all allusion to very recent policy) as a rule consolidated, strengthened ourselves, and made our ground sure before another advance. But there is a general impression that in other parts of the world we have been hastily and unfortunately acquisitive, whether we could help it or not; that the new provinces, districts, and protectorates are some of them weak to fluidity; that the great and unprecedented growth of the Empire has led to a stretching and thinning of its holding links which are overstrained by the weight of unwieldy extension and far beyond the help of a protecting hand. I hope to be able to show that in some important respects this suspicion is not altogether true; that science, human ingenuity and racial energy have given us some compensations, and that it is not paradoxical nor incorrect to say that our recent enormous growth of empire has been everywhere accompanied by a remarkable shrinkage of distances —by quicker and closer intercommunication of all its parts one with another and with the heart centre. In short, the British Empire, in spite of its seemingly reckless outspread, its sometimes cloudy boundaries, its almost vague and apparently meaningless growth, is at the present day more braced together, more manageable, and more vigorous as a complete organisation than it was sixty years ago. The difference between its actual extent in the last year of the century and its size at the date of the Queen's accession can be estimated by a glance at a remarkable series of maps published in the *Statesman's Year Book for* 1897, while since 1897, and at this instant, as we all know well, its mighty bulk is being still further increased.

The world as a whole has strangely contracted owing to a bewildering increase in lines of communication, to our more detailed geographical knowledge, to the formation of new harbours, the extension of railways, the increased speed and the increased number of steamships, and the greatly augmented carrying power of great sailing vessels built of steel. Then, hardly second in importance to these influences are the great land lines and the sea-cables, the postal improvements, the telephones and, perhaps we may soon add, the proved commercial utility of wireless telegraphy. This universal time-diminution in verbal and personal contact has brought the colonies, our dependencies, protectorates, and our dependencies of dependencies, closer to each other and all of them nearer still to us. Measured by *time-distance*, which is the controller of

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the merchant and the cabinet minister just as much as of the soldier, the world has indeed wonderfully contracted, and with this lessening the dominions of the Queen have been rapidly consolidating. Nor is this powerful influence by any means exhausted. In the near future we may anticipate equally remarkable improvements of a like kind, especially in railways, telegraph lines, and deep-sea cables, and in other scientific discoveries for transmitting man's messages through water, in the air, or perhaps by the vibrations of the earth. For us particularly, railway schemes of expansion must be mainly relied upon to open up and to connect distant parts of the Empire. Our true and only trustworthy road of intercommunication between the heart of the Empire and its limits must always be the sea. For general trade purposes, such as the convenience of business travellers, all continental lines and all the great projected railways will be helpful, whatever nation controls them; but our certain security is the sea, the sea which protects us, which has taught us to be an Imperial people. If we ever forget that, there may be a calamitous awakening. We must not be persuaded to build—or at any rate to place reliance upon—land roads or railways through regions inhabited by tribes and peoples over whom we have not complete military as well as political control. Persian, Arabian, North African railway projects are happily rarely heard of now. As national enterprises they never were and never could be practicable, or otherwise than dangerous mistakes. We are a world-power solely because of our worship and because of our command of the sea. In the future also we shall remain a world-power only so long as we hold command of the sea in the fullest sense of the term, not merely by the force and efficiency of the fighting Navy, but by the excellence and the perfecting of our mercantile marine, by increasing its magnitude, carrying power, and speed, and by anxiously attending to its recruitment by British sailors. We must not attempt to overtax our resources to guard railway lines through foreign semi-civilised or savage countries by exported or local armies. A heavy land responsibility lies upon us already. Under a little more we might be easily overweighted and crushed down. We must concentrate all our surplus energies upon our sea communications. Therefore the railway lines which I spoke of as helping to consolidate the Empire in the near future are those only which are projected or are being built in the various colonies and dependencies, lines to distribute and collect, to connect provinces, and feed harbours. The mighty Canadian Pacific Railway is unique in the Empire. It not only complies with all these requirements, but in addition it provides to Australia and the Eastern dependencies an alternative road, convenient and safe. As I said before, all railways, wherever built, will probably help us directly or indirectly in the long run, provided we are never committed to the protection of any one of them outside of our own boundaries.

And what has been said about railways applies, with obvious modifications, to telegraph lines and to maritime cables. The more general the extension of these, and the more numerous they become, the greater benefit will there be to this country in its double capacity as the greatest trader and the greatest carrier of merchandise in the world; while the

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actual equivalent to a diminution of time-distance in travelling is to be found in the instantaneous verbal message which can be despatched to the most distant point of the Empire. But we ought certainly to join all the shores of the Queen's dominions by sea-cables completely controlled by British authority. To rely upon connection between our own cables through telegraph systems stretching across foreign countries, however friendly, or to permit the ends of these sentient nerves of the Empire to emerge upon shores which might possibly become an enemy's country, is dangerous to the point of recklessness, that parent of disaster. As a melancholy instance of my meaning it is only necessary for us to remember the Pekin catastrophe—how we suffered from those dreadful intervals of dead silence, when we could not even communicate directly with our own naval officers at Taku, or with any one beyond Shanghai, although we have in our possession a place of arms at Wei-hai-Wei upon the Gulf of Pechili. It is obvious that we ought to have an all-British cable for pure strategic reasons as far as Wei-hai-Wei, our permanent military outpost on the mainland.

Now to give some suggestion of the increased facilities for carrying merchandise, for conveying passengers quickly about the world, and for the sending of messages to all parts of the earth, a few, a very few, salient facts may be quoted about ships—sailing ships and steam vessels —and about telegraphs and cables.

In 1870 there were no more than ten British sailing ships which exceeded or reached two thousand tons burden. In 1892 the yards on the Clyde alone launched forty-six steel sailing ships which averaged two thousand tons each. In 1895 the number of large steel sailing ships being built in the United Kingdom was down to twenty-three, and, speaking generally, it is inevitable that sailing vessels must give way to ocean steamships for most kinds of cargo—cattle, coals, wood, grain, oil, and everything else.

Now let us turn to the results in shortening journeys accomplished by the progress made in the construction and in the driving machinery of steamships within the last forty years, which has especially been fruitful in such improvements.

During this century the six months' voyage round the Cape to India became a forty and then a thirty days' journey by what was known as the overland route for mails and passengers through Egypt. By degrees it had become shorter still by the railway extensions on the Continent and by the unbroken steamship passage through the Suez Canal, until now the mails and hurrying travellers may reach London in twelve or fourteen days after leaving Bombay; and the great liners of the P. & O. Company can arrive in the Thames eight days later. This famous corporation, after her Majesty had been reigning nearly ten years, possessed only fourteen ships, with an aggregate of 14,600 tons. Now it owns a princely fleet of fifty-three ocean steamers, with a total capacity of 142,320 tons. Practically, the voyage to India in her Majesty's reign has been diminished by one-half at least.

Also since the Queen's accession the passage between the British Isles and the Commonwealth of Australia has grown shorter, from the ninety

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days taken by the sailing clippers to the fifty-three days occupied by Brunel's *Great Britain*. At the present time it lasts from thirty to thirty-five days by the Suez Canal route, while it has been finished in as little as twenty-eight days. Australia is consequently only half as far away, in time, as it was; while, if the Suez Canal were closed for any reason, we have at our disposal, in addition to the Cape route with its quick steamers, which is linked to us by the Pacific Ocean road, the splendid service of that Empire-consolidator, the Canadian Pacific Railway.

The important part played by the Suez Canal in this connection will be discussed a little later. Now I am merely indicating by a few well-known facts the diminution of distance by the improvements which have been made in the ships themselves and in their propelling machines.

Across the Atlantic the rapidity of travelling and the general average speed of all cargo steamers have increased remarkably. Very interesting statistics on this point were given to the British Association for the Advancement of Science last year, at Dover, by Sir William White in the Presidential Address of Section G. We may say, without repeating details, that during the last half of the nineteenth century the breadth of the Atlantic has practically been diminished one-half.

In 1857 the Union Company contracted to carry mails in thirty-seven days to the Cape. Now the contract time is nineteen days. This again diminishes the distances by one-half. As an instance of the remarkable change which has been made in steamships within forty years, it may be mentioned that the first *Norman* of the Union Company took forty-two days to reach the Cape, while the present *Norman* has covered the journey in fourteen days, twenty-one hours. I need not specify particularly the equivalent acceleration of speed upon other great steamship lines. All our sea distances have been shortened 50 to 60 per cent. in an identical way.

It is not too bold to predict that the Atlantic, from Queenstown to New York, will, before long, be steamed in less than four days. The question has now resolved itself simply into this—will it pay shipowners to burn so much coal as to ensure these rushing journeys before a cheaper substitute for coal is found? We know that a torpedo-destroyer has been driven through the water at the rate of forty-three miles an hour by the use of the turbo-motor instead of reciprocating engines. Consequently an enormous increase in the present speed of the great Atlantic liners is certain if the new system can be applied to large vessels. By such very swift steamers, and by the example they will set to all established and competing steamship companies, the journey to Canada and subsequently to all other parts of the Empire will be continually quickened, until predictions which would now sound extravagant will in a few years be simple everyday facts.

We must turn next to the subject of telegraphic communication, especially as it relates to the British Empire.

The mazes of land-lines and of sea and ocean cables are too numerous and intricate to be described in detail. Also the general effect of this means of bringing distant peoples together, and its transcendent importance for political, strategic, and trading purposes, need not be too

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much insisted upon in this place, so obvious must they be to every one. Yet, great as has been its power and advantage in all of those directions in the past, it is certain that still greater development and still greater service to the world will follow in the future even from existing systems, not to speak of their certain and enormous possibilities of growth. In the celerity of the actual despatch of a message we need not ask for much improvement. Lightning speed will be probably sufficient for our go-ahead children of the twentieth century. But where we may expect and shall undoubtedly get increased success is in multiplied facilities for sending telegrams all over the earth, and in widening their usefulness and convenience to all ranks and sections of the community. To obtain these necessary advantages there are two requisites—first, a great and general cheapening of tariffs and, as a certain consequence of such reduced charges, a duplication or even a quadrupling of many of the present cables to prevent blocking; and, secondly, an indefinite extension of both lines and cables everywhere. Progress in submarine telegraphy undoubtedly means a lessening in the price of service and a firmer control by the State, as an obvious corollary to the large help to the companies already given by the general tax-payer, quite as much as it means those scientific inventions and scientific discoveries which the coming years have in store for us. At the present time the charges are far too high, ridiculously so as regards India, and the use of the great cables is therefore very often beyond the power of the small capitalist and the trader of the middle sort. Yet certain and early news is of supreme importance to large numbers of both classes. Its absence hampers or stops business, while its price is too severe a tax upon average profits. This fact has led to the invention of ingenious and elaborate codes. They might possibly have been devised in any case; but there is no doubt that messages by code would be certainly expanded so as to prevent all possible ambiguity, if telegraphing to distant countries were not so costly. The spreading of land-lines and sea-cables about the earth has gone on rapidly since 1870; to the extent that those already completed would seem even to be in advance of their requirement, if that requirement were to be measured by their full employment. Nevertheless it is to be wished that new companies could be formed and new lines laid down to excite competition, and thereby to cheapen rates; or else that our Government should step in and regulate charges over subsidised British lines. For the power of the great telegraph corporations, by reason of their monetary resources, enables them to overcome ordinary rivalry and to treat public opinion with indifference. A general cheapening of rates has constantly been followed by increased profits, earned by the resulting augmentation of traffic, but it needs an enterprising directorate to face the necessary initial expenditure, except under pressure. Boldness and foresight in finance are naturally less prominent features in the management of the great telegraph companies than contentment with a high rate of interest on invested capital. All their energy and watchfulness are employed to crush competition rather than to extend their activities indefinitely. Moreover, money-making is their business, not Imperial statesmanship. If it were a question of the

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added security or the close coupling-up of the Empire (which are probably synonymous) on the one hand, and a loss of profit (however splendid the dividends might still remain) on the other, we know what would be the result of their deliberations.

Important as are the sea-cables for statesmen, for strategy, and for commerce, they are or will be equally important socially to keep up intimacy and swift intercourse between families half in Britain and half in India for instance, or between friends and relations in these Islands and in the great colonies. They might be made to give the sensation almost of actual contact, of holding the hand of your friend, of speaking directly to his heart. It is this interchange of personal news and private wishes, quite as much as the profound political and commercial aspects of lightning communication with all parts of the Empire, which will bind the Empire in bonds stronger than steel, easy as affection, to hold it together with unassailable power. Consequently the health and strength of the Empire depends very greatly upon a cheapening of telegraph charges. Doubtless a time will come when all our main cables of the first importance will be in the hands of Government, when they will only touch upon British territory, and when they will be all adequately protected from an enemy. Those are truly Imperialistic and patriotic aspirations. But we must never forget the grand part in bringing together, within whispering distance as it were, the different parts of the world, and consequently of our world-wide Empire, which has been taken in the past by such Napoleonic organisers as the late Sir John Pender. It is to him and to such men as he that we owe those splendid beginnings which by means of vital reflexes from the nerve-centre of the Empire have helped to fire our white fellow-subjects all over the globe with a loftier patriotism and with new, brave, and broader ideals of nationality.

It was coincident with the opening of the Suez Canal in 1869 that the liveliest interest began to be taken in sea-cables, and a master mind perceived their commercial possibilities. Before that time the success of the constructing companies had not been great. Sir John Pender then founded the famous Eastern Telegraph Company by the amalgamation of four existing lines, which had together laid down 8500 miles of sea-cables, besides erecting land-lines also. A year later, in 1873, from three other companies he formed the Eastern Extension Australasia and China Telegraph Company, which jointly possessed 5200 miles of submarine lines. From that date the extension of electric communication to all parts of the earth, over wild as well as over civilised countries, and beneath the salt water, has only been equalled by their average remunerativeness. Now there are 175,000 miles of submerged cables alone, of which this country owns no less than 113,000 miles. The history of some of these cables is full of interest, and might attract the delighted attention of the lover of picturesque romance no less than of the student of commercial geography. It also supplies suggestions and many facts, both to the physical geographer and to the student of seismic phenomena. Science has taught the companies to economise time, labour, and material in cable-laying operations, as well as how to improve the working instruments. Human ingenuity, business perception, and organising

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power have shown once more their startling possibilities when directed and controlled by cool, clear-eyed intelligence combined with general mental capacity.

It is only necessary to reaffirm, for the reasons already given, the national, the imperial, the commonwealth requirement for cheap telegraphy, and the profound necessity there is both strategically and politically for complete government control by purchase, guarantee, or other equitable means over main cables which connect Great Britain with her daughter states, her Indian empire, and her dependencies. Our communications with our own folk must be independent of private companies and completely independent of all foreign nations.

All the details which I have given are illustrative of man's successful energy and of his progressive ingenuity in enslaving the great forces of the earth to diminish distance, to shorten world-journeys, and to speed world-messages. Another human achievement, the piercing by Lesseps of the Suez isthmus, has had remarkable consequences. It had been talked of in England centuries ago. Christopher Marlowe makes Tamerlane brag—

> "And here, not far from Alexandria,
> Whereas the Tyrrhene and the Red Sea meet,
> Being distant less than full a hundred leagues,
> I meant to cut a channel to them both
> That men might quickly sail to India."

The illustrious French engineer solved one great problem in 1869, only to originate others which are of profound importance to commercial geography—and to the British Empire most of all. The Suez Canal has brought India and the Australasian Commonwealth wonderfully near to our shores. It has greatly diminished many time-distances, but why has it not injured our Eastern trade? Also is there any danger or menace of danger to that trade? From the very beginnings of the great commerce, the Eastern trade has enriched every nation which obtained its chief share. It has been the seed of the bitterest animosities. It alienated Dutch and English, blood relations, co-religionists, co-reformers, into implacable resentment, and bitter has the retribution been. On the other hand it brought into temporary alliance such strange bedfellows as the Turks of the sixteenth century and the Venetians. At the present day what international jealousies and heartburnings has the same rivalry not fostered! For all the trading peoples know how vital is that traffic.

In the earliest days of commercial venturings the Eastern trade focussed at Alexandria, afterwards at Constantinople and the Italian "factory" stations of the Eastern Mediterranean. Barbarous upheavals in Central Asia interrupted the current at times, but only as temporary dams. Then came Vasco da Gama's voyage round the Cape and its sequels—the diversion of the rich merchandise of the Orient from the Italian ports and from the Eastern Mediterranean to the sea-coast cities of the Atlantic. Out of the relentless scramble of the Atlantic nations for this, the grandest of the trader's prizes, the English came out bloodily

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triumphant and the British have remained the dominant shippers ever since. But when the Suez Canal was trenched through, a geographical reversal followed: the merchant's chief path may be said to have left the Cape circuit and to have regained the old line, with immensely added facilities, to debouch upon the Eastern Mediterranean. Why has it not affected us more profoundly? Are not geographical canons outraged by the great steamers passing by the French and Italian ports to find distributing centres in these islands? I think that theoretically it is so, even admitting that the foreign harbours are more difficult than ours. Practically only a few industries have suffered; the volume of our trade has increased greatly, and it still remains easily pre-eminent. One of the chief explanations I believe to be this: Geographical considerations were defeated, for the time at any rate, by the excellence of our banking system when the Suez Canal was opened. The wealth of the country, then as now, instead of being separated and divided into isolated patches, was accumulated in the hands of bankers and was readily and easily available for commercial enterprises. So the necessary steamers—huge, and of special line—were built at once by our companies and launched into the valuable Eastern trade before their rivals could begin to stir. This country had the invaluable help of its monetary facilities. Wealthy shipping corporations, once fully organised and successful, have great power, by reason of their reserves and resources, to hustle and to ride off the attacks of weaker and less-experienced competitors. Supposing this great change had but just occurred—our advantages, though still distinct, would have been less remarkable. And in the future international trade jealousy will be keener and the competition even more severe. We must not forget that our geographical position is no longer in our favour for steamships plying from the East, and, as in the immediate past, we must throw away no chances, but seek to make up for that admitted defect by foresight, by education, by maintaining and constantly adding to our experience, and by defending and supporting that admirable system—our national banking system—which has carried us over seemingly insurmountable obstructions to brave trade triumphs.

The general considerations which I have named might lead to the inference that actual geographical disadvantages, in trade competition for instance, may sometimes be conquered by man's resourcefulness and energy. Within obvious limitations that is certainly true. At places, as we know, the borderland between geography and many of the natural sciences is often vague and confusedly interlaced. So perhaps also with mechanical and economic science our boundaries at certain spots overlap. Quick steamers, far-reaching telegraph lines, and the piercing of isthmuses by ship-canals may at the first glance appear outside the purview of the geographer. Yet from that particular aspect of geography which I have already spoken of as the Science of Distances we perceive how relevant they are, how worthy of study. Truly ours is a very catholic science, and we have seen how even the comparative value of national banking systems may help to explain seeming geographical inconsistencies, to reconcile facts with possibly unexpected results, and to show how the human element modifies, perhaps, the strictly logical conclusions of the

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geographer intent upon physical conditions alone. It is for the statesman and the philosopher to speculate upon the character and the permanency of such influences. Our success as an Empire will probably depend for its continuance upon a high level of national sagacity, watchfulness, and resource, to make up for certain disadvantages, as I think, of our geographical position since the cutting of the Suez Canal; and it will also depend upon the comprehensive and intelligent study of all branches of geography, not the least important of which to my view is the Science of Distances—the science of the merchant, the statesman, and the strategist.

THE GEOGRAPHICAL SECTION OF THE MEETING OF THE BRITISH ASSOCIATION AT BRADFORD, 1900.

President.

SIR GEORGE ROBERTSON, K.C.S.I.

Vice-Presidents.

SIR JOHN MURRAY, K.C.B., F.R.S.; SIR THOMAS H. HOLDICH, K.C.I.E.; H. R. MILL, D.Sc., LL.D.; J. SCOTT KELTIE, LL.D.; E. G. RAVENSTEIN.

Secretaries.

H. N. DICKSON, B.Sc., F.R.S.E., F.R.G.S. (*Recorder*); EDWARD HEAWOOD, M.A., F.R.G.S.; E. R. WETHEY, M.A., F.R.G.S.

Committee.

COLONEL F. BAILEY, *late* R.E.; VAUGHAN CORNISH; DR. H. O. FORBES; STAFF-COMMANDER DUBOIS PHILLIPS, R.N.; T. G. ROOPER; ELI SOWERBUTTS.

Delegates from the Royal Scottish Geographical Society.

COLONEL F. BAILEY; GEORGE SANDEMAN.

The following papers were read in the Geographical Section:—

THURSDAY, SEPTEMBER 6TH.

1. *The President's Address,* which is printed on another page.
2. *Geographical Teaching in the West Riding,* by T. G. ROOPER.
3. *Commercial Geography in Education,* by E. R. WETHEY.

FRIDAY, SEPTEMBER 7TH.

4. *The Treatment of Regional Geography,* by H. R. MILL; an account of his monograph on South-West Sussex, of which an abstract is given in the *Geographical Journal,* March and April 1900.

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5. *Foreign and Colonial Surveys,* by E. G. RAVENSTEIN.

6. *Military Maps,* by B. V. DARBISHIRE. The author indicated that our Ordnance map is primarily a military map, made by soldiers for the use of soldiers, and discussed the best form of map for the use of troops in standing camps in this country, and for volunteers encamped for their annual training. He enumerated the points on which maps can give information which is useful, and even necessary, for carrying on military operations, as follows:—

(*a*) Rivers, streams: Width, nature of banks; fords, bridges, ferries, locks.
(*b*) Roads: Width, surface; whether enclosed or not; whether ditches alongside.
(*c*) Railways: Double or single track; embankment or cutting; tunnels.
(*d*) Woods, copses, heather, gorse.
(*e*) Villages: Size, shape; houses, how placed to roads, so as to favour attack or defence.
(*f*) Hedges and ditches.
(*g*) Footpaths.
(*h*) Detached houses.
(*i*) Physical features ("Terrain").

1. Specimens of British Manœuvre maps.
2. The British Ordnance map as a Manœuvre map.
   Completely satisfactory except as regards (*i*) (Terrain) and scale.
3. Representation of relief, various methods used for Ordnance maps.
   (*a*) Contours alone. Great Britain, Italy, United States, Switzerland.
   (*b*) Shading alone. Germany.
   (*c*) Contours with shading. Switzerland, Norway, Austria-Hungary, Great Britain.

The paper concluded with a description of the ideal manœuvre map, with all its topographical details.

7. *Journeys in Central Asia,* by Captain H. H. P. DEASY.

This paper dealt with explorations in Western Tibet and Chinese Turkestan, begun in 1896. The most important features of this explorer's work are, first, the extensive use of triangulation for determining longitudes from peaks, fixed by the Great Trigonometrical Survey of India, and heights; secondly, the discovery of the sources of the Khotan river; and thirdly, the detailed survey of that exceedingly difficult mountainous region, the hitherto unknown stretch of the Yarkand river.

The continued opposition of the Chinese added considerably to the physical difficulties encountered, and resulted in the explorer and his assistant being incapacitated from work by severe illnesses. The latter compelled Captain Deasy to return to India much sooner than he had intended.

It is of interest to note that the heights of about 250 peaks were determined, and over 40,000 square miles of country surveyed. Much valuable assistance was rendered by the Indian Government, especially by the Surveyor-General, and several officers of the Foreign Department.

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8. *Large Earthquakes recorded in* 1899, by JOHN MILNE, F.R.S.

In 1899 at Shide, in the Isle of Wight, 130 earthquakes were recorded. The greater number of these were also observed at Kew, whilst very many of them were common to registers from Canada, the Cape of Good Hope, India, Java, Japan, and other distant countries.

Analysis of these records has increased our knowledge respecting the rates at which motion is transmitted through our world, and indirectly thrown new light upon its rigidity. The arcual velocity of surface waves has been investigated, and new rules, based on these investigations, have been formulated for determining the position of earthquake origins. It has, for example, been shown that the distance of an origin from a given station can be determined either from the interval by which the preliminary tremors outrace the larger surface waves or from the interval between the arrivals of waves which had travelled from their origin round the world in opposite directions.

With this knowledge it is frequently possible for an observer in any part of the world to name the district from which an earthquake recorded at his observatory has originated.

One series of observations showed that the amplitude of the large waves of earthquakes decreased more rapidly when traversing sub-oceanic paths than when they radiated over continental surfaces. In discussing the nature of large waves this observation on the damping effect of oceans was used as an argument that this form of seismic movement represented gravitational surface waves rather than the outcrop of distortional waves propagated through the body of the world.

One hundred and twenty-five out of the 130 records considered represented disturbances which had sub-oceanic origins. The principal of them may be grouped as follows :—

1.	North-eastern Pacific, W. of British Columbia, . .	14
2.	East Mid Pacific, W. of Southern California, . .	5
3.	East Southern Pacific, W. of Peru and Chili, . .	8
4.	West Pacific, off Japan, ...	19
5.	West Mid Pacific, near Java, ...	12
6.	Mid Indian Ocean, ...	9
7.	North Atlantic, east side, ...	17
8.	West North Atlantic and West Indies, . . .	6
9.	Mid Equatorial Atlantic, ...	5

If we except the second group we see that the Pacific origins are on the face or at the bottom of "deeps," which form portions of the trough or troughs around the eastern and western margins of that ocean. If future soundings show that the indicated exception is only apparent, then the second group will also illustrate the rule that accelerations in secular adjustments of the earth's crust are most frequent where this exhibits the greatest flexure.

Inasmuch as there are reasons for believing that each of these earthquakes was accompanied by large mechanical displacements of solid materials, the importance of localising the sites, where such changes are frequent, is evident to those who select routes for deep-sea cables.

Although we are not in a position to say that these displacements are sufficiently large to produce a measureable effect on the moment of inertia of the earth, attention may be directed to the fact that at those times when changes in latitude have

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been marked, large earthquakes have been frequent, whilst, when they have been few, such changes have been less pronounced.

Another subject of interest to those engaged in geodetic work is the fact that changes in the rates of pendulum time-keepers may sometimes be traced to the unfelt movements of large earthquakes, which so frequently disturb all countries in the world.

9. *The Report of the Committee on the Climate of Tropical Africa.*

MONDAY, SEPTEMBER 10TH.

10. *Railway Connection with India,* by Col. Sir THOMAS H. HOLDICH, K.C.I.E.

This paper, which will be published in the Society's *Magazine*, dealt with the general geographical conditions of South-west Asia, which may favour a scheme of railway connection with Western India, the subject-matter of the successive sections of the paper being as follows :—

1. The impracticability of the northern approaches to India leading over the Hindu Kush into Kashmir or Afghanistan from the Oxus regions.

2. The nature of the great transverse water divide of Asia, which includes the Hindu Kush, and the most favourable points for crossing it.

3. The opening afforded by the Hari Rud river to the west of Herat.

4. The configuration of the Persian plateau and mountains, and its adaptation to railway alignment.

5. Consideration of Persian lines of communication with Western India. The coast-line between Basra, at the head of the Persian Gulf, and Karachi. Details of alignment. Commercial and climatic objections to such a line as far as Bandar Abbas.

6. Alternative central line from Western Persia to Bandar Abbas. Difficulties of connection with European systems.

7. Details of alignment between Bandar Abbas and Karachi. Difficulties of coast-line, and possibility of interior central line.

8. The proposed connection between Kushk and Chaman (*i.e.* the Herat-Kandahar line). Geographical conditions that exist between Kushk and Herat, and between Herat and Kandahar. Their favourable nature.

9. Objections which have been raised to the line—political and military. Its commercial prospects.

11. *The Siberian Railway,* by C. RAYMOND BEAZLEY.

This paper gave an account of the route traversed by the Siberian railway as far as the Amur, and of the connections of the main trunk with the regions to the north and south ; first, as already made ; second, as in construction and projected. Mr. Beazley described the bearing of the Siberian line on Central and Southern Asia by the intended link from Tashkent to Orenburg ; the primary commercial and industrial purpose of the line west of Lake Baikal ; the development of the country through the movements created by the railway, including population, mining enterprises, agriculture, cattle-raising, and manufactures. Further points studied were—the connection of the railway with river naviga-

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tion (1) of the West Siberian rivers, Ob, Yenisei, etc.; (2) of the Kama and Volga; (3) of the Dvina and Petchora; its connection with the western ocean and inland seas, and with Russia's strips of ice-free coast and ice-free ports in the west, on the Arctic Ocean, the Black Sea, and Caspian.

12. *On the Possibility of obtaining more Reliable Measurements of the Changes of the Land-Level of the Phlegraean Fields*, by R. T. GÜNTHER. The author has communicated to us a statement of his projected researches, which appears on another page.

13. *The British Antarctic Expedition*, 1899-1900, by C. E. BORCHGREVINK.

Mr. Borchgrevink touched upon the origin of the expedition which he commanded, referring to his previous work within the Antarctic Circle, and to the resolution which was carried at the Sixth International Geographical Congress at the Imperial Institute in 1895. The voyage of the *Southern Cross* with the results of some of the principal observations (both meteorological and magnetic), the landing, the camp, and the work of the land expedition from March 1899 to March 1900 were described. An account of the principal discoveries made during one year on South Victoria Land was given, as well as a description of the ice conditions, in winter and summer, near Cape Adare and in the pack.

The author claims as the principal work of the expedition (1) the pioneer work in Victoria Land, extending over a period of one year, thus for the first time proving the possibility for an expedition to live on South Victoria Land in the winter. (2) Recording the meteorological and magnetic conditions at Cape Adare and at various places on the ice, and on the mainland between this locality and the 78th parallel, thus locating the present approximate position of the South Magnetic Pole, in lat. 73° 20′ S. and long. 146° E., about 220° W. by N. from Wood Bay. (3) Discovery of new antarctic species, with special reference to the shallow-water fauna and the flora of South Victoria Land, both proving bi-polarity, and suggesting a theory of the distribution of organisms. (4) Touching upon the importance of the discovery of insects as indicating an average temperature in the neighbourhood of the locality where they were found, not deviating much from what was experienced during the years 1899-1900. (5) The most southerly latitude reached was 78° 50′.

14. *Through Arctic Lapland*, by C. J. CUTCLIFFE HYNE. Mr. Hyne's address, admirably illustrated by photographs, dealt in detail with the mode of life of the Laplanders.

15. *The Revision of the Physical and Chemical Constants of Sea-Water.*—Report of the Committee, consisting of Sir JOHN MURRAY, (Chairman), Mr. J. Y. BUCHANAN, F.R.S., Dr. H. R. MILL, Mr. H. N. DICKSON (Secretary). Drawn up by the Secretary.

The Committee was appointed to co-operate in the investigations undertaken by Dr. Martin Knudsen at Copenhagen, at the instance of the Committee appointed by the International Conference held at Stockholm last year with

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the view of making authoritative determinations of the constants used in reducing observations of the physical and chemical conditions of sea-water in different parts of the globe.

The grant placed at the disposal of the Committee has been expended in defraying part of the cost of Dr. Knudsen's researches.

Dr. Knudsen reports that the work of obtaining samples of water from different regions has been completed, except with regard to those from the East Greenland polar current, the northern part of the Baltic, and the Indian Ocean, which it is to be hoped will be received in about a month's time. The samples have been collected in six-litre bottles, prepared by standing full of hot water for a month before use. Dr. Knudsen and his assistants began preliminary work in September last, and since May the regular analyses of samples have been carried on by himself, two chemists, and three physicists. The results obtained so far indicate that the methods employed are adequate in scope and precision, and sufficient progress has been made to justify the expectation that the work will be completed and published within the time arranged by the Stockholm Committee.

The Committee do not ask to be reappointed.

TUESDAY, SEPTEMBER 11.

16. *Some Consequences that may be anticipated from the Development of the Resources of China by Modern Methods*, by GEO. G. CHISHOLM, M.A., B.Sc.

The author pointed out that various causes are already in operation tending to bring about that development in spite of the opposition of some sections of the people. These are of such a nature as to make it unlikely that this development, however brought about, will be long retarded.

When it does come about, this development is bound to have world-wide effects on a scale of extraordinary magnitude, and in one direction it seems probable that it will tend to reverse the tendency of the last generation in the economic history of the world.

The peculiarity of the position of China is this, that it is the one region in the world with all the means for industrial development on a gigantic scale that remains to be opened up. In the past thirty or forty years we have chiefly seen the opening up of new countries or old countries without great resources for industrial development.

Among the consequences that may be anticipated from this opening up are these:—

1. A rise in prices in China, especially in the industrial regions.

2. The creation of a demand for food-stuffs not likely to be supplied by China itself; a demand which in itself will be one of the most powerful causes contributing to maintain the rise in prices.

3. The imparting of a great stimulus to the food-producing regions most favourably situated for meeting this demand, more particularly Manchuria, Siberia, and western North America, probably the Pacific States of North America to a greater extent than Canada.

4. Perhaps the most important of all, the creation of a tendency to a gradual but prolonged rise in wheat and other grain prices all the world over, reversing the process that has been going on since about 1870 in consequence of the successive opening up of new countries.

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17. *The Commercial Resources of Tropical Africa*, by EDWARD HEAWOOD, M.A.

At least 70 per cent. of the total trade of Africa falls to the countries of the extreme north and south, leaving the whole of Tropical Africa with an area of some nine millions of square miles, a total trade of at most £30,000,000, of which nearly £7,000,000 belongs to the small islands of Mauritius and Réunion. The object of the paper was to examine the causes of this small commercial movement as compared with that of other tropical countries, and to form some conclusion as to the permanence, or the reverse, of present conditions.

Among historical reasons for the smallness of the existing trade are (1) the attraction exercised during the age of great discoveries by America and the East and the consequent neglect of Africa; (2) the political condition of the African peoples; (3) the effects of the slave-trade; while geographical causes are found in (1) the massive form of the continent and consequent absence of natural means of communication; (2) the unhealthiness of the coastlands. That many of these causes are not necessarily permanent is shown by a comparison with Brazil, which affords a close parallel with Tropical Africa in many respects. This shows that, given natural resources capable of supporting an increased export trade, the commercial future of Tropical Africa need not be hopeless.

The resources of a new country may be classed as (1) exhaustible, principally minerals; (2) permanent, chiefly animal and vegetable products, the second group being the more important. It may be again subdivided into (1) jungle products, which, though not necessarily exhaustible, are likely to suffer diminution; (2) cultivated products. The former may, under cultivation, be transferred to the latter sub-group, which is the most important of all. In Brazil, *e.g.*, the vast preponderance of the exports is made up by the four products, coffee, sugar, tobacco, and cotton. Rubber and timber, at present jungle products, and cacao, make up the seven principal resources of Brazil. In Tropical Africa jungle products, principally rubber and palm-oil and kernels (total annual value, over £4,000,000), are at present those on which the export trade mainly depends. A period of development of plantation products has, however, set in, and coffee, cacao, cotton, tea, etc., have been grown with success in various parts. The chief difficulties to be encountered arise from (1) want of means of transport; (2) scarcity of labour; but these are now in a fair way to be overcome. The modern tendency for each country to depend for tropical produce largely on its own colonies must favour the commercial development of Africa, while the comparatively low population of Africa per square mile renders it probable that it will in the future play an important part in providing a food supply for the more thickly peopled continents.

18. *On Snow Ripples and Sastrugi*, by VAUGHAN CORNISH, M.Sc., F.C.S., F.R.G.S.

These observations, made in Scotland last winter, are preliminary to a general investigation of the surface forms of snow, which the author proposes to continue in a colder climate during the coming winter. The investigation is undertaken in connection with the author's research upon the waves and wave-like surfaces of the atmosphere, hydrosphere, and lithosphere.

The general conditions during the following observations are: ground already covered with snow, temperature a little below the freezing point.

Case I.—Snow falling sparsely. In absence of wind the surface was uneven,

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owing to clinging together of flakes. In a light breeze there was a notable tendency for the prominent parts to arrange themselves transversely in ridges, the distance from ridge to ridge not more than one inch. When the breeze freshened these became regular ripples, with a smoothed surface of closer texture. One set of measurements gave the distance between successive ridges, 1·125, 1·225, 0·85, 1·05, and 1·00 inch. Their amplitude was approximately ·05 inch, which gives a ratio Length : Height = 21 approximately. The steep face of these ripples is on the windward side, whereas in sand ripples and water waves the steep face is on the sheltered side. The normal movement is downwind, the most noticeable feature of the process being the retreat of the steep weather face, consequent upon the abrasion of its surface. For occasional short intervals, however, during lulls and during moments of heavier snowfall, the ripples rush upwind, owing to the sudden deposit of snow upon each weather face.

Case II.—Fresh breeze without snowfall, blowing upon uncompacted snow. The surface was beautifully covered by ripples of 3 inches to 15 inches from ridge to ridge, which were rapidly increasing in size. The steep side faced the wind. The ridges, which were pretty accurately parallel one to another, were transverse to the wind, but with much sinuosity, no ridge being straight for more than a few inches. It is evident that the wind must be concentrated in the re-entrant angles of the steep weather slope, and this would tend by rapid erosion to destroy the arrangement of long transverse lines which is the most obvious characteristic of ripples. The ridges, however, did not lose their transversality, which was apparently preserved by the greater deposit of drifting snow in these re-entrants, which stopped the threatened gaps; and by the collapse of the overhanging cornice of uncompacted snow at the salient angles, by which these promontories were truncated.

Case III.—The latest fallen layers of snow having been blown away, the wind acts upon compacted snow (this was generally in drifts which had become exposed owing to change of direction of wind). The wind abraded a fine granular "drift," which did not adhere to the smooth hard surfaces. Parallel lines of bevelling or grooving transverse to the wind are the most conspicuous feature of the resulting structure in the compact, almost homogeneous, fine-grained material. The lines are much freer from minor irregularities than the ripples described above. As the action continues, however, the sinuosities are emphasised, for, the "drift" not adhering well, the re-entrants are cut back more and more behind the salients. Further, the wind concentrating along the lines of the re-entrants, the general level of the surface here is lowered more quickly by abrasion than is the case along the intermediate lines of the salient angles. Thus is produced a well-marked form transitional between snow ripples and *sastrugi*, in which intermediate form the transverse ridges are crossed at right angles by alternate ridges and furrows parallel to the wind, the furrows being along the line of the re-entrants.

Sastrugi.—This action went on until the ridges transverse to the wind were merely a subordinate and scarcely noticeable feature, and the snow was seen to be in great ridges parallel to the wind. These corresponded perfectly with the *sastrugi* of the Tundras as described by A. Penck[1] on the authority of F. Schmidt and G. Bore.

On the opposite orientation of snow ripples and sand ripples.—Ripples in loose sand have their steep faces on the leeward, snow ripples on the windward side. The exposed face of the snow ripple becomes steeper than the sheltered face,

[1] *Morph. der Erdoberfläche*, vol. i. pp. 388-9.

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because the cohesiveness of the snow while in mass enables the wind to carve out wind caves, in which its force is concentrated. In loose sand the slipping of the material prevents this. The friability of the snow also assists in the effect, the detailed explanation of which would, however, be too long for this abstract.

Observations were also made upon the forms of snowdrifts, and photographs were taken of ripples, *sastrugi*, and drifts.

19. *The Geographical Distribution of Relative Humidity*, by E. G. RAVENSTEIN.

The author stated that the importance of relative humidity as a climatic factor was fully recognised. Having illustrated its influence upon organic life, upon agriculture and human industries, he expressed his regret that neither in number nor in trustworthiness did humidity observations meet the requirements of a person desirous of illustrating its distribution over the globe by means of a map. This was owing largely to defects in the instruments employed, incompetence of the observers, and unsuitability of the hours chosen for the observations. As to the humidity over the ocean, we were still dependent upon the observations made on board passing vessels, and he was afraid the time had not yet come when floating meteorological observatories would be stationed permanently throughout a whole year at a few well-chosen localities in mid-ocean. Notwithstanding this paucity of available material he had ventured, in 1894, to publish in Philip's *Systematic Atlas*, a small chart of the world showing the distribution of humidity. The subject had not been lost sight of by him since then, and he now placed the results before this meeting. He did so with some diffidence, and over-cautious meteorologists might condemn his action, but they must remember that when Berghaus, in 1838, acting upon suggestions made by Zimmermann and Humboldt, published the first isothermal chart, the observations on temperature were even less numerous than those on humidity were at present. His charts, of course, must be looked upon as sketches, but he felt confident that they brought out the broad features of the subject, and, to reduce the sources of error, he had limited himself to indicating four grades of mean annual humidity, the upper limits of which were respectively 50 per cent. (very dry), 65 per cent., 80 per cent., and 100 per cent. (very damp). The relative humidity over the oceans might exceed 80 per cent., but in certain regions ("horse latitudes") it was certainly much less, and in a portion of the Southern Pacific it seemed not to exceed 65 per cent., a feature seemingly confirmed by the salinity of that portion of the ocean, which exceeded 3·6 per cent.

His second chart exhibited the Annual Range of Humidity, viz., the difference between the driest and the dampest months of the year. In Britain, as in many other parts of the world, where the moderating influence of the ocean was allowed free scope, this difference did not exceed 16 per cent., but in the interior of the continents it occasionally exceeded 45 per cent., spring or summer being exceedingly dry, whilst the winter was excessively damp, as at Yarkand where a humidity of 30 per cent. in May contrasted strikingly with a humidity of 84 per cent. in December.

This great range directed attention to the influence of temperature (and of altitude) upon the amount of relative humidity, for during temperate weather we were able to bear a great humidity with equanimity, whilst the same degree of humidity, accompanied by great heat, such as is occasionally experienced during the "heat terms" of New York, and recently visited London, may prove

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disastrous to men and beasts. Hence, combining humidity and temperature, the author suggested mapping out the earth according to sixteen *hygrothermal types*, as follows:—

1. Hot (temperature 73° and over) and very damp (humidity 81 per cent. or more)—Batavia, Camaroons, Mombasa.
2. Hot and moderately damp (66-80 per cent.)—Havana, Calcutta.
3. Hot and dry (51-65 per cent.)—Bagdad, Lahore, Khartum.
4. Hot and very dry (50 per cent. or less)—Disa, Wadi Halfa, Kuka.
5. Warm (temperature 58° to 72°) and very damp—Walvisch Bay, Arica.
6. Warm and moderately damp—Lisbon, Rome, Damascus, Tokio, New Orleans.
7. Warm and dry—Cairo, Algiers, Kimberley.
8. Warm and very dry—Mexico, Teheran.
9. Cool (temperature 33° to 57°) and very damp—Greenwich, Cochabambo.
10. Cool and moderately damp—Vienna, Melbourne, Toronto, Chicago.
11. Cool and dry—Tashkent, Simla, Cheyenne.
12. Cool and very dry dry—Yarkand, Denver.
13. Cold (temperature 32° or less) and very damp—Ben Nevis, Sagastyr, Godthaab.
14. Cold and moderately damp—Tomsk, Pike's Peak, Polaris House.
15. Cold and dry—
16. Cold and very dry—Pamir.

The actual mean temperature of the earth amounted, according to his computation, to 57° F., and this isotherm, which separated types 8 and 9, also divided De Candolle's *Mikrothermes* from the plants requiring a greater amount of warmth.

The author further illustrated his paper by a number of diagrams giving the curves of the temperature, rainfall, and humidity, as also by a chart of the world exhibiting the number of rainy days.

20. *The Origin of Moels and their Subsequent Dissection*, by J. E. MARR, F.R.S.

In this paper, the influence of vegetation in modifying hill-outlines was first considered, and it was shown that the concave curve of water-erosion is partly replaced by a convex curve of weathering on the upper parts of hills, with herbaceous vegetation in temperate regions, and often entirely replaced by a convex curve in tropical regions, where the sides of the hills are clad with forest growth.

The dissection of such round-topped hills or moels by stream action was then considered, and it was pointed out that buttress-like lateral peaks will be formed around the resultant central peak. Lateral peaks of this nature have been described by Mr. I. C. Russell, on Mount Rainer, under the name *tahomas*; he gives reason for their production by glacial denudation in that particular case.

21. *On the Pettersson-Nansen Insulating Water Bottle for Antarctic Oceanography*, by H. R. MILL, D.Sc., LL.D.

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THE LAND OF PARROTS.

By Captain PASFIELD OLIVER.

CONCLUSION.

AN EARLY FRENCH VOYAGE TO MADAGASCAR EXAMINED.

IN 1857 M. Varnhagen[1] having presented to the Geographical Society at Paris his *General History of Brazil*, M. d'Avezac was instructed to report on it for that Society, and this eminent geographer read an important paper on the subject, which has since been published, entitled *Considérations géographiques sur l'Histoire du Brésil*, in which the author revindicated the claims of the old French voyagers to have first visited this part of the New World. He quoted the testimony afforded by the record, found in Ramusio's[2] famous collection of voyages, of the voyage of Captain Jean-Denys of Honfleur to Brazil in 1504; and he also stated that the appearance of French ships at Bahia in that same year had likewise been mentioned in contemporary Portuguese documents,[3] as related already by Estancelin.[4] M. d'Avezac gave M. Pierre Margry full credit for his fortunate discovery of Baron de Gonneville's dossier in which Brazil is specially mentioned, of which he then merely mentioned the chief points, and founded certain arguments (to be given hereafter) that Gonneville never went east of the Cape of Good Hope, but must have found his Land of Parrots somewhere on the South American continent, north of the tropic of Capricorn, probably in the country of the Goaitacas, at the mouth of some river about the size of the Orne on the shore of the Calvados promontory. Such was M. d'Avezac's solution of the problem over forty years ago. The full text of M. Margry's find was not printed until ten years subsequently in 1867,[5] when, independently of M. d'Avezac's previously expressed opinion, he came to the same conclusion.

Two years after the publication of M. Margry's *Navigation du Capitaine de Gonneville*, in January 1869, the well-known curator of the *Bibliothèque de l'Arsenal*, M. Paul Lacroix,[6] whilst examining the manuscripts of the Marquis de Paulmy, found a MS. pamphlet (*plaquette*) of twelve leaves, in quarto (on paper known as "*pot*"), indorsed H.F. 24 ter., which

[1] Francisco Adolfo de Varnhagen, *Historia geral do Brazil*, 1857.

[2] *Navigatione et Viaggi raccolti*, par Gio. Battista Ramusio (Venezia, Giunti, 1563-74-56), 3 vols.; tome iii. fol. 357 F.

[3] *Revista Trimensal do Instituto historico, geographico, e ethnographico do Brasil*, tom. vi. pp. 412-413. *Enformacão do Brasil et suas capitanias.*

[4] *Recherches sur les voyages des navigateurs Normands*, 1832, par Louis Estancelin.

[5] *Les navigations Françaises et la Révolution Maritime du XIVe. au XVIe. siècle, d'après les Documents inédits. . . .* sm. 4to. 1867, par Pierre Margry. The chapter discussing the voyage is entitled "La Navigation du Capitaine de Gonneville et les prétentions des Normands à la découverte des Terres Australe sous Louis XII.

[6] M. Paul Lacroix is better known to bibliophiles under his pseudonym of "Bibliophile Jacob."

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attracted his attention, and finding it referred to the ancient voyage of Binol Paulmier de Gonneville, he forwarded it to M. d'Avezac, whose previous report on this subject he was well acquainted with. The writing was evidently that of the early eighteenth century (or late seventeenth century), and M. Lacroix pointed out that the entire document had been registered in an authentic act of August 1658. In the same year M. d'Avezac published the full text of this manuscript in the *Annales des Voyages* for June and July 1869, with a compendious account of previous researches and publications relating to the subject. His instructive article has been republished by M. Challamel aîné in form of a brochure entitled "Campagne du navire L'ESPOIR de Honfleur—1503-1505—*Relation authentique du voyage du Capitaine de Gonneville ès nouvelles terres des Indes publiée intégralement pour la première fois, avec une introduction et des éclaircissements*, par M. d'Avezac, membre de l'Institut" (Paris, 1869).

The MS. is headed *Authentic Relation.* | The persons in charge of the Admiralty of France | at the general seat of the marble table of the palace at Rouen | we make known | that from the registers of the office of the said seat, in the year one thousand five hundred and five | has been extracted and collated with the original minute that which follows. | *First Part.* | Declaration of the Voyage | of Captain Gonneville and his companions to the Indies, | and remarks made during the said voyage | delivered to Justice by him, Captain, and his said companions | just as required by the officers of the King our Sire | and has been enjoined by them.

Then follows the *First Section*, relating to the armament of the ship, etc. Each section, of which there are four, is subdivided under several headings. It would exceed the space at our disposal to give the whole relation at length, so it may be best to shortly indicate the contents of each section and sub-section, and only give in detail those sub-sections which so far deal with the actual navigation as to indicate in some measure the course of the ship *Espoir*. 1. *Origin and end of the enterprise.* First, the deponents state how, when trading in Lisbon, Gonneville with two merchants, witnessing the rich stores of spices and rarities brought to that city from the East Indies, resolved to fit out a vessel for the same trade, and for that purpose hired at a high rate of wages two Portuguese who had just returned from the East. 2. *The owners and the ship.* The names of the owners, all townsmen of Honfleur, are given, who equipped a vessel of 120 tons, the *Espoir*, for the voyage. 3. *The arms and munitions of war* are then enumerated. 4. *Naval material and spare stores.* 5. *Victuals.* 6. *Merchandise for traffic.* 7. *Constitution of the crew and dispositions for sailing.* On board the ship there embarked sixty souls in all; with Captain de Gonneville in command, Colin Vaseur as pilot, etc. The ship sailed from Honfleur on the 24th June 1503.

Second Section.—Sub-section 8. *From Honfleur to Cape Verd.*—In about eighteen days they reached the Canary Islands, on the 12th July, and went on shore at Cape Verd, where they purchased rice, fowls, and victuals for beads and trinkets. 9. *From Cape Verd to the Equator.*—

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They again put to sea on the 9th August, and took a course far from the coast of Africa to avoid the dangers and pestilence of its coast, and thence they had a favourable wind, which continued quite six weeks. 10. *Passage of the Line.*—They say that the line of the Equator was passed over by them on the 12th of September, and they saw both on this side and beyond, going and returning, flying fish by bands, as starlings do in France, having wings like flitter-mice, and approaching in size a white herring; moreover, they saw *dorados* (dolphins), porpoises and other fishes, which the sailors caught and cooked. And thence sea-sickness (scurvy) began in the ship, by which two-thirds of the crew were afflicted; and the Sieur Coste of Honfleur, who made the voyage from curiosity, died of it (and others whose names are given), . . . and from thence they commenced steering by the (Southern) Cross of the other Pole.

Having proceeded thus far from the complete MS. of the Marquis de Paulmy, it may be interesting to interpolate this first portion of the voyage as given by the Baron de Gonneville, so that the wide discrepancies may be noted in the two statements, both purporting to be copied from the original declaration, as follows:—"They say that having weighed anchor at the said date of June, on the report of the riches of the Portuguese in the New World, and with the idea of finding a continent yet larger, at the port of Honfleur, in the embouchure of the Seine, they came straight to that of Lisbon, passed to the Great Canary, from thence to the west coasts of Africa, called Cape Verd, in the month of August, next after crossing to Brazil. They made a traverse of more than eight hundred leagues without seeing any land, with the greatest discomfort of the world, always demented by the rain and tempest, in great darkness, so far that they feared for their life and had great fear. It happened that the said captain was very clever in navigation, and they were forced to double the Cape of Augustin—it was in November—and in this course to the south they ran something like six hundred leagues, less badly than they could expect."

Baron de Gonneville's version.

But being by that voyage at the heighth of the stormy Cape, battered by a furious and excessive wind, without remarking any bay, they were abandoned to a calm in a sea which they did not know and could not divine, not knowing where they should turn, unable to reach the coasts, and losing them from view, so that their spirit and heart failed from the pursuit of their design, without other succour than that of their instruments to see the elevation of the sun and to arrive at a happy discovery. But

Marquis de Paulmy's version.

11. *Floating seaweeds met with.*—*Item.*—They say that eight days after All Saints [1st Novbr. 1503 to 9th Novbr.] they saw floating in the sea long and large reeds with their roots, which the two Portuguese [pilots] said to be the sign of the Cape of Good Hope, which gave them great joy; and because they did not see the birds called velvet-glove [*Manche de velours*], they estimated the ship's course to be well beyond the said Cape; as also that they felt a much greater cold.

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having at the time remarked some birds which came from the side of the south, without being able to recognise too well the sign of a continent being near, to soon hope to find a land where they had good reason to reach on account of repair and water and want of victuals, they trimmed all their sails and ran pretty swiftly before a good wind from the south, on which the crew worked with all their might, until spent and much fatigued they perceived a continent in January one thousand five hundred and four, around which a great quantity of the said birds soared and flew about in the neighbourhood, among which number were found many parrots different by their colours, which rejoiced them and set them at ease, so that they jumped with joy and contentment. Afterwards they were much amazed at seeing a very fine and great river, which resembled that of the Orne, which bathes the walls of the town of Caen in the province of Normandy.

They stayed there for the said refitting and to make the provisioning of the said ship, much battered and deprived of everything, for the duration of six months, during which they often proceeded inland and went to visit the villages in the country, the inhabitants and their houses, of which a map was drawn by Nicole Lefebvre.

12. *Contrary winds.*—They say that thence they began to have weather and wind contrary, so that for the next three weeks [30th Novbr.] they made no progress. And, moreover, Collin Vasseur died, their principal pilot, from sudden apoplexy, which was the great loss of the voyage.

And the said misfortune was followed by others, namely, by rude storms, so vehement that they were forced to let the ship run for some days at the mercy of the sea, at random, and lost their course; by which they were much afflicted, for the need they had of water and to be refreshed on shore.

13. *Discovery of a great land.*—They say that the storm was followed by some calms, so that they advanced but little. But God comforted them; for they began to see many birds coming and going from the southwards, that which made them think from that they were not far from land: wherefore to go there they had to turn back from the East Indies. Necessity made them change their course, and the fifth January [Janry 5, 1504] they discovered a great land, which they could not reach until the evening of the following day [6th January], a contrary wind off shore being against them, and they anchored in good soundings. And on the said day some of the crew went on shore to reconnoitre; and on the following morning [7th Janry.] the barge was sent to range the coast in search of a port, and returned in the afternoon, and conducted the ship into a river which it had found, which is the same size as that of the Orne.

Third Section.

Sojourn in the new lands of the Indies.

14. *State of the ship and resolutions in consequence.*—They say to have stayed in the said country until the following July [July 1504] for they

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had found the ship so worm-eaten and rotten that she had great need of repair; for which not a little time was employed by want of skilled labourers and instruments. From whence the ships' company had occasion to wish to return to France refusing to navigate from the said place to India, saying the said sea had not yet been navigated by Christians, the season had been lost, the principal pilot likewise, in whom was the mastery of the voyage; and what was more, that the said ship was judged not fit to undergo such voyage. So that for all these reasons and others, which nearly all signed for the discharge of the captain, the return to Christendom was advised.

15. *Character and manner of living of the Natives.*—Item, they say that during their stay in the said land they conversed pleasantly with the people thereof, after they were become sociable with the Christians, by means of the welcome and little gifts which were made to them. The said Indians being simple folk, only caring to lead a joyous life without hard work; living by hunting, fishing, and that which their land gave of itself, and some vegetables and roots which they planted; going half naked, the young and common people especially. They wear mantles, some of light matting, some of skin, some of featherwork, like those of the Egyptians and Bohemians in these countries, only that they are shorter, with a kind of apron girt about their haunches, going to the knees of the men, and below the knees of the women; for men and women are draped in the same manner, although the garment of the woman is longer.

And the females wear collars and bracelets of horn and shells: not the man, who carries instead bow and arrow, having for point a bone properly sharpened, and a spear of very hard wood burnt and sharpened at the end, which is all their armour.

And the women and girls go with uncovered head, having their hair neatly twisted with little knots of grapes dyed in bright and shining colours. As for the men, they carry long flowing hair, with a crest of high plumes, brightly coloured and well arranged.

16. *Fecundity of the country.*—They say, moreover, to have entered into the said country quite two days distance, and along the coasts still further, both to the right and to the left; and to have remarked the said country to be fertile, and provided with strong beasts, fishes, trees, and other singular things unknown in Christendom. . . .

17. *Habitations.*—Item, they say the said country to be peopled throughout, and the dwellings of the Indians are in hamlets of thirty, forty, fifty, or eighty huts, made, in the manner of market-places, of stakes driven in one close to the other, entwined with reeds and leaves, with which also the said habitations are covered; and there was for chimney a hole to let the smoke through. The doors are of sticks neatly joined; and they shut them with wooden latches, similar to those made in Normandy for gates and stables. And their beds are of soft mats filled with leaves or feathers; their coverlids of mats, skins or feather-

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work, and their household utensils of wood, even their cooking-pots, but plastered with a sort of clay, as thick as a finger, which prevents the fire from burning them.

18. *Government.*—Item, they say to have remarked the said country to be divided by little cantons, of which each has its king; and that the said kings are not any better lodged and dressed than the others, yet they are much revered by their subjects: and none is so hardy as to dare refuse to obey them; they having power of life and death over their subjects; of which some of the crew saw an example worthy of remembrance, namely, of a young son, from eighteen to twenty years, who, in a certain hot temper, had given a blow to his mother; which his chief having known, although his mother had not complained of it, he sent to fetch him, and had him thrown into the river, a stone to his neck—called by public outcry the young men of the village, and other neighbouring villages, and none of them could obtain remission, not even the mother, who went on her knees to beg pardon for her child.

19. *The king and his family.*—The said king was the same in whose territory the ship was staying, and had the name Arosca. His country was a good day's journey [in extent], peopled by about a dozen villages, of which each had its particular captain, who all obeyed Arosca.

The said Arosca was, as it seemed, aged sixty years, then a widower, and had six sons, from thirty to fifteen years, and he came, himself and his children, often to the ship. A man of grave demeanour, middle stature, stout, and good-natured countenance, in peace with the neighbouring kings, but he and they fighting with some people who are inland, against whom he went twice whilst the ship lay there, leading from 500 to 600 men each time. And the last time, on his return, great joy was demonstrated by all his people, for having had a great victory, their said wars being only excursions of a few days against the enemy. And he had a great desire that some of the crew might accompany him with fire-arms and artillery, to create panic and put to rout his said enemies, but they excused themselves from it.

20. *Outward distinctions.*—Item, they say that they have not remarked any particular marks which differentiate the said king and other kings of the said country, of which there came some five to see the ship, except that the said kings wore the plumes of their head of one sole colour: and usually their vassals, at least the principal ones, wore as their head-plumes, some sprays of feathers of the colour of their chief, which was green for that of the said Arosca their host.

21. *Welcome made to Europeans.*—Item, they say that had the Christians been angels descended from heaven they could not have been better treated by these poor Indians, who were all wonder-struck by the size of the ship, the artillery, mirrors, and other things which they saw in the ship, and, above all, by the fact that by a written letter, which they sent from board to some of the crew who were in the villages, they could make them know what they desired, not being able to understand

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how the paper could speak. Also because the Christians were feared by them, and for the sake of some little gifts which they made them of gilt [objects] knives, hatchets, mirrors, glass beads, and such trinkets, so loved, that for them they would willingly have been cut in quarters, bringing them abundance of meat and fishes, fruits and victuals, and whatever they saw to be agreeable to the Christians, like skins, plumage, and roots for dyeing, in exchange for which they gave them ironmongery, and other requirements of little value, so that of the said commodities there was amassed nearly a hundred quintals, which in France would be worth a good price.

22. *The planting of a Cross.*—Item, they say that wishing to leave marks at the said country that it had been visited by Christians, a large cross of wood was made, with a height of thirty-five feet and more, well painted; which was planted on an eminence in sight of the sea, with a goodly and devote ceremony, drum and trumpet sounding, on a day expressly chosen, to wit, the day of the great Easter, one thousand five hundred and four. And the said cross was carried by the captain and principal men of the ship with naked feet; and the said chief Arosca and his children assisted, as well as other Indian chiefs whom they had invited for honour; and they showed themselves joyous. The ship's company followed under arms, chanting the Litany, and a great crowd of Indians of all ages, for whom, for a long time before, a fête had been held, quiet and very attentive to the mystery.

The said cross being erected, many discharges of musketry and artillery were made, a feast and suitable presents to the said lord Arosca and the Indian chiefs; and for the populace there was only some largesse of some little trifles of small cost, but prized by them, the whole in order that they should have remembrance of the fact: giving them to understand by signs and otherwise, as well as they could, that they were to preserve and honour the said cross.

And on it was engraved, on one side, the name of our Holy Father, the Pope of Rome, of the King our Sire, of Monseigneur the Admiral of France; of the captain, the bourgeois and companions from the greatest to the smallest. And the carpenter of the ship did this work, which gained him a present from each of his companions. On the other side was engraved a numeral Latin distich, fashioned by Monsieur Nicole le Febure abovenamed, who in this gentle manner declared the date of the year of the erection of the said cross, and who had erected it; and had it [placed] there:—

HIC SACRA PALMARIVS POSVIT GONIVILLA BINOTVS;
GREX SOCIVS PARITER, NEVSTRAQVE PROGENIES.

23. *Dispositions for the Return.*—They say, moreover, that at last the ship having been repaired, refitted and furnished as well as they could for the return, was made ready to depart for France. And because it was the custom for those who visited new countries of the Indies to bring thence to Christendom some Indians, such was done by good pretence, that the said Arosca was willing that his young son, who was

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generally on good terms with the ship's crew, should come to Christendom, because they promised to the father and son to bring him back within six moons at the latest; for thus they made them to understand months. And what increased their desire, they made them believe that those who should come with them should learn artillery; which they greatly wished for, to enable them to master their enemies; as also to make mirrors, knives, hatches, and all that they saw and admired among the Christians; which was as much as promising like one might promise to a Christian gold, silver and gems, or to learn the philosopher's stone.

All which things firmly believed by the said Arosca, he was pleased that they wished to take his said young son, who had the name Essomericq; and gave him for a companion an Indian, aged thirty-five or forty years, called Namoa. And they came, he and his people, to escort them to the ship, bringing much food and many fine plumes and other rarities, to make as presents on his part to the King our Sire. And the said Lord Arosca and his people awaited the departure of the ship, making the captain swear to return within twenty moons; and on the said departure all the said people raised a great cry, and gave to understand that they would preserve the cross; making the sign thereof by crossing two fingers.

Fourth Section.

THE RETURN VOYAGE.

24. *Bad weather and sickness.*—Item, they say that at length they left the said Southern Indies on the third day of July five hundred and four, and afterwards did not see land until the day after Saint Denys [10th October], having met with divers fortunes, and much tormented with malignant fevers, by which many of the ship were infected, and four died of it, to wit, Jean Bicherel, of Pont l'Evesque, the ship's surgeon; Jean Renoult, soldier of Honfleur; Stenoz Venier, of Gonneville sur Honfleur, the captain's valet, and the Indian Namoa.

And there was some doubt as to baptizing him, to avoid the perdition of his soul; but the said Monsieur Nicole said that it would be profane baptism in vain, because the said Namoa did not acknowledge belief in our mother Holy Church, as those ought to know who receive baptism having the age of reason; and the said Monsieur Nicole was trusted as the best scholar of the ship. And nevertheless after there had been some scruples; so that the other young Indian Essomericq, being ill and in danger, was, by his advice, baptized; and the said Monsieur Nicole administered to him his sacrament, and his godfathers were the said de Gonneville, captain, and Antoine Thiéry; and instead of a godmother Andrien de la Mare was taken for third sponsor; and he was named Binot, from the baptismal name of that captain. It was the fourteenth of September that this was done. And it seems that the said baptism served as medicine to the soul and body, for thereafter the said Indian became better, was cured, and is now in France.

25. *Putting in at another land.*—They say there the said illnesses to

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be caused by the water of the ship being putrified and stinking, and also by the air of the sea, as they could remark, insomuch that the air of the land, and fresh meat and water cured all the sick. Wherefore, knowing the cause of their illness they wished above all for land. Indeed, the tropic of Capricorn passed, by observation, they found themselves to be more distant from Africa than from the country of the West Indies, where for some years past the people of Dieppe, St. Malo, and other Normans and Bretons had come to seek red-dye wood, cottons, monkeys, parrots and other commodities. So that the wind from the east, which they have remarked to reign customarily between the said tropic and that of Cancer, impelling them there, it was unanimously decided to go to seek that country, in order to freight themselves with the said merchandise to recoup the cost of the voyage. And they arrived there the day following Saint Denys as above said [10th October].

26. *The Inhabitants pourtrayed.*—Item, they say that there they found the Indians, rude, as naked as coming from their mother's womb, men and women; very few of them having their nakedness covered; painting their body, notably of black; the ears pierced, the holes garnished with green stones properly polished and arranged; incised in many parts of the skin with scars, in order to appear more handsome youths; the beards partly shaved. For the rest, cruel eaters of men; great hunters, fishers and swimmers. They lie suspended in beds made like a net. They are armed with large bows and wooden clubs, and have not among them either a king or masters; at least not that they ever remarked.

Besides they inhabit a fine country, a land fertile in fruits, birds and animals; and the sea full of fishes: the species different from those of Europe. And they make bread and drink from certain roots.

27. *Maladventure among the Cannibals.*—They say, moreover, that in parts of the said country which they landed on there had already been Christians, as was apparent by the commodities of Christendom which the said Indians had. Also they were not astonished at seeing the ship; and nevertheless they feared above all the artillery and arquebuses.

And having bravely gone on shore, as some of the companions were drawing water, and others were inland without arms, not fearing anything, they were treacherously attacked by those wicked Indians, who killed a page of the ship named Henry Jesanne. They took and led into the woods Jacques l'Homme, called La Fortune, soldier, and Colas Mancel, mariner, all of Honfleur; and these two poor fellows were lost without possibility of giving them assistance.

There were, moreover, still on shore four men, who gained the barge and were saved, all wounded save one; and so one of the said men died in the first hour of his reaching the ship. This was the said Monsieur Nicole Le Febure abovementioned, who, for curiosity, of which he was full, had landed on shore, and he was regretted by all, as deserving a better fate, for he was prudent, affable, and of knowledge.

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28. *New Anchorage at one hundred leagues further.*—Item, they say that this piteous occurrence caused them to quit the place of this misadventure, and to proceed up the coast a good hundred leagues higher up; where they found some Indians of the same kind. But from these last they received no harm; and when they had taken counsel they had not come to the chief, because the event which had happened made them not trust in him.

And there, whilst the ship remained, she was loaded with provisions and merchandise of the said country previously told of, in quantity quite full up, and in detail contained in the complaint and grievance stated to Justice against those who have pillaged the ship, in appeal. And the value of the said merchandise would have sufficed to defray the voyage, and good profit besides, if the ship had come to a safe port.

29. *Definite departure.*—Item, they say that they departed from the said country between Saint Thomas' and Christmas five hundred and four, having caught two Indians, whom they thought to bring to France; but on the first night they cast themselves into the sea, the ship being then at more than three leagues from the coast: but these gallants are such good swimmers that such a distance does not affright them.

30. *From Brazil to the Azores.*—Item, they say that they did not see anything worthy of remark more than what they saw in going, except that seven or eight days after the embarkment, they saw an uninhabited islet covered with verdant woods, from whence thousands of birds flew out, so much that some came to perch on the masts and rigging of the ship; and let themselves be taken. And the said birds appeared large in feathers, although the same plucked were of small size.

And in five weeks, after many tackings, with a wind from the southwest they repassed the Line, and again saw the North Star.

Then there were variable winds, and some storms. And they met with in one sea grass joined with great weeds, granulated with round grain like vetch or thereabout, entwining with long filaments; and yet the sea is there so deep that, the lead cast, no bottom was found.

And at length, believing to be only in the latitude of the Canary Isles, they sighted the Azores, and anchored at Fayal on the ninth of March, and there they had victuals and other things of which they had need. The said Azores are inhabited by Portuguese.

31. *Attack by Pirates.*—[Describes how the *Espoir* was attacked by an English corsair, Edward Blunt, and a Breton pirate, Morris Fortin, and how in trying to escape the *Espoir* ran on the rocks at Jersey.]

32. *Return to Honfleur.*—[From Jersey the survivors reached La Hogue, and finally arrived at Honfleur on the 20th May 1505.]

33. *Motives of the Declaration*—[States that the survivors went to make their complaint about the piracy to which they had been subjected, and the King's officials had required the captain and the chiefs of the

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ship to make a declaration of the facts of the voyage, which was accordingly done and signed on the 19th of June 1505.]

This ends the first part and completes the original narrative of the voyage.

The second part of the Marquis's manuscript contains a copy of the Letters-royal in form of an injunction conveying an order for the deliverance of the Extract or "Vidimus" of the Declaration of the Voyage of Captain de Gonneville, addressed, in the name of the King, Louis XII., to the officials of the Admiralty at Rouen, in 1658, with which the present paper cannot deal.

It may be added that the signatures of de Gonneville, de la Mare, and Thiéry do not seem to have been witnessed by any official of the Admiralty at Rouen in 1505; and again the manuscript of the Marquis de Paulmy is only a copy, and this does not seem to be officially verified, nor is the date of this copy given.

By comparing the extract quoted by de Brosses from the Abbé Paulmier's *Mémoires*, it is evident that the text is the same as that of the Marquis's MS.; without the headings, however, which seem to be more modern interpolations. For instance, take the mention of Brésil in the heading of sub-section 30. The word "Brésil" does not appear in the text beneath or in the Abbé's text. The modern name "Açores" in the heading is spelt "Essors" in the text beneath.

It must be confessed that there are grave reasons for doubting the authenticity of the complete account. It is a great pity that such should be the case.

Now it will be at once noticed that the three accounts which we possess of Gonneville's voyage differ considerably one from the other. Canon Paulmier's version, of 1663, merely suggests that the *Indes méridionales*, where Gonneville landed, may have been to the south-east of the *Terre des Perroquets* already reported by the Portuguese as existing south of the Cape of Good Hope. He relates how "the French sailors were consoled by the sight of many birds which seemed to come and go from the southern side," when they had lost their route. Whilst Baron de Gonneville's version of 1783, one hundred and twenty years afterwards, has improved upon this statement, adding, "they approached a continent in January, 1504, about which a great quantity of the said birds turned and soared in the neighbourhood, among which number were found many parrots of different colours. It would seem as if this mention of parrots had been suggested by the allusion in Paulmier's *Mémoires*. Next Baron de Gonneville's version mentions the discoverers crossing from the Cape de Verd to the Brazil coast, and doubling Cape Augustin, on their outward voyage. In the Marquis de Paulmy's MS., 1658, the French voyagers touch at Cape de Verd, but do *not* cross to Brazil, but merely keep at a sufficiently long distance from the African west coast to avoid its dangers and pestilence. *No parrots whatever* are mentioned in this last version of 1658. It must be borne in mind that Canon Paulmier had been searching, previous to the publication of his *Mémoires* in 1663, for evidence in order to escape taxation as an alien; and it seems probable that the MS. found among the Marquis de Paulmy's

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papers may have been obtained by the Canon at the date named in the *acte authentique* of 1658.[1]

Assuming, however, for the sake of argument, that the Marquis de Paulmy's complete MS. is what it purports to be, a true copy of the original declaration of the captain of the ship *L'Espoir*, made before the Admiralty officials of Rouen, in 1505 (at least so far a true copy that it has been rendered into the French of the more modern period of 1658, for it is evidently not the French of 1505), let us now examine the log of the *Espoir* from Cape de Verde to the unidentified land of King Arosca.

Leaving Cape Verd on the eve of Saint Lawrence, 9th August 1503, and keeping it some distance from the pestilential coast of Africa, the *Espoir* having crossed the equator on the 12th September, continued with favourable wind until the 20th September, being six weeks from leaving Cape Verd. Banks of drift seaweed were encountered on the 9th November, but no sea-birds, such as are usually seen near the Cape. From this, and from the excessive cold, the two Portuguese pilots (who had previously made the voyage round the Cape) declared that they must be in latitudes much higher than that of the Cape, and altered their course for the East Indies. On this track the vessel encountered for three weeks contrary winds, and did not make much progress until the 30th November, when the principal pilot, Collin Vasseur, died, after which a series of gales and storms ensued, before which the ship was driven at the will of the winds and waves—evidently drifting along with the Antarctic current, which sets to the eastward in these latitudes. The crew were now in great need of fresh food and water. The reckoning had by this time been entirely lost. Probably the chief pilot had been the only navigator capable of taking astronomical observations, the second pilot having only a general knowledge of the various local points from previous voyages. The storms seem to have now carried them north into far lower latitudes;[2] for, after being becalmed (during which they would drift with the current), and it must be remembered that as the ship was making for the East Indies its course would have been north-north-east for some time. It was now *five* weeks since they had doubled the Cape—as the pilot had supposed—numbers of sea birds were seen going and coming *from* the south, possibly, it may be suggested, *to* the west. The vessel was by this time within the region of the south-west trades, so trimming their sails the sailors naturally turned in the direction towards which the birds were seen flying, *i.e.* south-west, and soon an extensive coast line was visible on the 5th January 1504, which a land breeze prevented them from reaching until the 6th. On the 7th January the ship's barge discovered the embouchure of a small river, the size of

[1] 1658 is the year in which de Flacourt's book was published mentioning Arosca. *Vide ante*, Part I. p. 14.

[2] It may be remembered that the vessel in which François Leguat sailed, the *Hirondelle*, having left Cape Town on the 13th February 1691, proceeded south to lat. 40° by the 15th of March; and, being caught by a tempest, lost its reckoning and drifted like the *Espoir*, until, on 3rd April, it found land, which proved to be the Isle Bourbon. It may be presumed that the *Espoir* may have taken a somewhat similar course.

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the Orne, into which the *Espoir* safely entered the same day. I can conceive of no land which is more likely to fulfil the conditions obtainable from the meagre details furnished by the MS. than the south-east coast of Madagascar.

Again, taking the return voyage, let us examine the probable course of the *Espoir*. The Frenchmen record that they departed from this unknown land—*les dites Indes méridionales*—on the 3rd of July 1504. Nothing whatever is said about their course at starting. But, still, it may be remembered that they must have fancied that they were in a southern part of the Indies, and therefore beyond the Cape. So that they must have shaped their course accordingly to double the Cape of Good Hope from the eastward. Anyhow, from the 3rd July to the 10th of October, a period of *fourteen* weeks—over three months—they were at sea, apparently, without sighting land. A few days before the 10th of October, however, after sailing north of the tropic of Capricorn, they found the ship's position to be nearer to the West Indian than to the African coasts. Indeed the navigators are said to have been aware that the Norman and Breton sailors had been accustomed for some years to trade to Brazil[1] for dye-woods, cottons, monkeys, and parrots. So the owners of the *Espoir* decided to put in before the south-east trade to one of the Brazil ports, where they arrived on the 10th of October. The assaults of the cannibals at this place caused the crew to remove their ship one hundred leagues farther up the coast, where the vessel obtained a cargo. The *Espoir* left Brazil between St. Thomas, 21st December, and Christmas, 25th December, 1504, and eight days afterwards sighted an island covered with trees and myriads of birds. Five weeks subsequently, *i.e.* 26th January 1505, the ship repassed the line, anchored at Fayal in the Azores on the 9th March, and next put into Ireland for repairs. On the 7th May, whilst off Jersey and Guernsey, the *Espoir* was chased by an English pirate, Edward Blunt of Plymouth, and a French pirate, named Mauris Fortin. In trying to escape the *Espoir* was wrecked on the coast of one of the Channel Islands, and thence the survivors reached the Port de la Hogue, and finally Honfleur, on the 20th May 1505.

M. d'Avezac, as I have previously noticed, at first had placed Gonneville's unknown land in the country of the Goaitacàs, on the east coast of the South American continent, north of the Tropic of Capricorn; but, on obtaining the fuller version of the Marquis de Paulmy, he found that it must needs be south of that tropic, and accordingly he came to

[1] Vincent Pinçon, Diego de Lepe, Pedro Alvarez Cabral only discovered Brazil towards the latter end of the year 1500, whilst Almerigo Vespucius did not reach this coast until yet later. So M. d'Avezac is able to place the French sailors at the commencement of the sixteenth century (or end of the fifteenth) on a par with the immediate Portuguese successors of Columbus; always taking it for granted that the authenticity of the Marquis de Paulmy's manuscript can be relied on. It is really vexing to think that there must always exist considerable doubt on this important point. A Captain Cousin of Dieppe is—by a vague tradition—supposed to have reached the River Amazon in 1488, whilst the brothers Parmentier, celebrated in verse by the poet Pierre Crégnon, are said to have traded to Brazil in 1539. Vide *Les Navigateurs Francais*, par Léon Guerin.

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the final conclusion that it must be looked for in the shores formerly inhabited by the Carijòs. He found the most suitable spot at the mouth of the river San Francisco do Sul, in 26° 10′ south. According, however, to the recent ethnographical map of South America in the 16th century, as drawn by Senor Luiz L. Dominguez, the coast at the mouth of the San Francisco was inhabited by the Mbiazai, south of the Tapiis. At the same time M. d'Avezac admits the uncertainty of the locality. He argues that the characteristics of the Carijòs, as chronicled by Simon de Vasconcellos from the records of Gabriel Soares, well agree with the description of the Indians depicted by Gonneville. M. d'Avezac lays stress on the usage of the hammock as used by the Goaitacàs, but it must be remembered that Gonneville did not find the hammock among Arosca's people. It was not until Gonneville had left Arosca's country for a space of *fourteen* weeks and crossed the Atlantic that he met with the people who used hammocks. And supposing Gonneville had landed at Francisco de Sul, would it have taken him *fourteen* weeks to reach his next station on the coast of South America, wherever it may have been? Probably Gonneville touched at some such places as Rio de Janeiro, and next at Bahia de Todos Santos. Besides, had Gonneville and his pilots been on a coast south-west of Brazil, a country with which they apparently knew the French had trading relations, they must surely have known on what continent they were cast. I think that this length of voyage to a port of Southern Brazil puts the country of the Goaitacas and that of the Carijòs equally out of the question.

The only point which militates against the Madagascar theory is that the inhabitants are represented as using bows and arrows. But, considering the vagueness and inaccuracy of the important points of the voyage, it is quite possible that the statements of the sailors regarding the inhabitants of the several places touched at became somewhat mixed.

All practical sailors and navigators have agreed that Gonneville's story best agrees with the Madagascar coast; and, if so, it is to the French that the first discovery of Madagascar should be credited, in January 1504, two years before the re-discovery of that island by the Portuguese in February 1506.[1]

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[1] PARIS, *le* 23 *Janvier* 1900.

MONSIEUR,—En réponse à votre lettre du 18 Janvier, je vous autorise volontiers à reproduire certains passages de l'ouvrage de M. d'Avezac, "Relation authentique du voyage du Capitaine de Gonneville"; à la condition, bien entendu, de citer l'ouvrage.

Veuillez agréer, Monsieur, mes salutations empressées.

A. CHALLAMEL.

A Monsieur PASFIELD OLIVER.

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ROBERT SMITH, B.Sc., University College, Dundee.

SOME eight years ago there came to University College, Dundee, a youth, evidently very closely engaged in business, yet making at every available moment a run to college, and losing no chance of extending an already unusual knowledge of the natural sciences, among which botany evidently stood first. For here he came as no tyro, but with that every-day familiarity and open-air interest which only those can bring who have known and lived with nature from their earliest days, and who have grown gradually into its study in the home atmosphere, absorbing nature-lore from parents and elder brothers from childhood, like music, or language itself. Punctual at every class, never missing an experiment, a specimen, or an idea, bringing from occasional week-end rambles trophies floral and cryptogamic which often testified to the keenest eye, the longest tramp, the most daring climb, his quiet and almost self-effacing manner could not long keep his very distinct personality from notice amid students and staff; first, as one of mark and promise, and soon as one of light and leading. Though always primarily a naturalist, the very keenness of his interest in life made him widen into broader and broader sympathies, and this alike with books and men; till there could be no better case of the happiest interaction of college and student. Thus our at first shy and retiring youngster soon and naturally ripened into a real leader of College life, and this on all its sides.

One of those rare but invaluable students whose keen interest relieves them from all lower ambitions of material success, and whose clear grasp from all depressing fears of failure, he raised the tone of every class he entered, and that without even knowing it. His influence was, of course, soon appreciated by the teaching staff, and utilised in demonstrating, in which he soon disclosed a new talent—that of the born teacher, who can set every one to work; and this not in College only, but with an influence gradually spreading on either hand, to the simplest labouring men in their Naturalists' Field Club, or to the youngest children of his holiday tutorship. Despite his slightness of frame he was something even of an athlete; not only the most untiring in the long excursions in which he specially delighted, but the swiftest of swimmers, the most amphibious of divers in the College club, through all his years. In magazine or debating society he was fertile and keen; yet in the occasional social evenings of the College Union, or the merry summer evening tea-makings and home-comings of the botanical excursions, he was always ready to exchange exposition and discussion for a new leadership in song. A young life, growing in all ways swiftly (and as it seemed as strongly) as the wild flowers he most loved; as simply and as purely also.

After leaving business, from which his call was too manifest not to be obeyed, he was for a time an effective assistant in the growing zoological museum of the College, where many preparations remain to attest his skill. Then, returning to botany, his minute interest in specific and structural details on one hand, his love of general nature aspects on the

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other, alike found fresh stimulus and guidance in that school of botany where these too often separate outlooks are at present most fully combined—the admirable Botanical Institute of the renascent University of Montpellier. From the winter laboratory work, relieved by long and delightful mapping expeditions with Professor Flahault, he returned laden with golden opinions, to demonstrate at Dundee. He continued to develop as a teacher, not only giving his best to the best students, but arousing the love of nature even when most dulled or dormant, sparing no personal pains, even of private and voluntary tutorial toil, until even the most backward could not but "get through." He was soon appointed College lecturer, and last session conducted the whole

ROBERT SMITH, B.SC.

work of the department of botany to the fullest satisfaction of all concerned; while he had also independently acquired a widening influence upon the rising current of nature-study and of technical instruction in neighbouring towns.

From that vivid wander-year after his long apprenticeship, with its experience of the meeting of many floras, Northern and Mediterranean, Alpine and Pyrenean, which explains the repeated pre-eminence of Montpellier as a botanical centre, he returned fully ready to begin that Botanical Survey of Scotland, of which the first finished sheets here published (presented to the Society only on the 8th of May last) speak for themselves. Even these two maps but incompletely indicate the breadth and thoroughness of his scheme, the extent and aim of his strenuous and untiring survey, with its wealth of observation broad

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and minute, of interpretations cautious and shrewd, of generalisations lucid and strong.

How a life of such unflagging strenuousness, of such intellectual and physical intensity had involved a habit of overwork, of too reposeless rhythm of nerve and muscle, we now see only too clearly; though the joyous productivity of both activities veiled the overstrain from self and friends alike, till it was too late. Hence what may have been warning symptoms seemed mere passing trifles. Yet the fatigue and exposure inevitable to the surveyor's work must have been doing deadly work upon a wearied frame, so that an attack of appendicitis on his return from a long and apparently satisfactory expedition was suddenly closed by syncope. Obiit 28 Aug. 1900; æt. 26.

. . . . . .

In the unending progress of science, even more than in ordinary life, the last word cannot be of personal sorrow, nor of academic or educational loss, not even of affection and admiration, but of the definite work done, and of the tasks left to be continued.[1] Here, then, is a vital beginning in Scottish, nay in general, geography; for these sheets represent what fairly promised to be the fullest and most thoroughly detailed botanical survey as yet of any region of the earth. Its relation to Professor Flahault's botanical and forest survey of France was from the first amicably adjusted, while that to the corresponding surveys in America is even now being considered by American botanists. The following up of this sound and well-studied initiative is thus not only possible and practicable, but is an obvious and urgent matter for practical co-operation and division of labour. For us in Scotland, at least, it is worth notice that alike in personal type and scientific work we have in him the latest example of that regional tradition of nature-knowledge, that frequently out-cropping vein of genius to which we owe not only Don, and many another keen and ardent observer, but even Robert Brown "facile princeps botanicorum," and Lyell himself—Forfarshire naturalists all.

To relate this regional survey of Scotland to the larger world he spent much time and study upon the colouring of two large (metre quadrant) globes, one at College in Dundee, the other at the Outlook Tower in Edinburgh; and from these a copy has been made in Paris, and is now in the Exposition.

Thus this bright young life, despite its premature close, has not failed either of personal success or of enduring influence. The personal joy of literally seeing and grasping the world from fresh and ever-freshening points of view, of observing its beauty and unravelling its order, of correlating its minutest details with its vastest landscapes, was constantly and increasingly his—the delight of recovering the world-outlook of Linnæus and of Humboldt upon the returning spiral of botanic and geographic progress. Nor has he failed in initiating a *magnum opus*, a regional, national, even international survey, of which the interests and uses in science are rich and manifold, and the practical possibilities and issues in wealth and in common weal are no less than great. P. G.

[1] An appreciation in both respects is in preparation by M. Flahault himself.

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THE GREAT DAM OF HOW WATER.

By H. CRAWFORD ANGUS.

SOUTH AFRICA is undoubtedly a country of enterprise; and among all the enterprises that have of late years been started to develop the resources of the country, the construction of the How Water dam holds one of the highest places.

How Water is situated in the north-west portion of Cape Colony, between Britstown and Prieska, the nearest railway station being De Aar; and it was as a trooper in Roberts's Horse, on the way to Prieska to drive out the rebels who had occupied the town, that by the kind permission of the late Captain Majendie, our commanding officer, and the courtesy of Mr. Smart, the manager of the estate, I was enabled to inspect the dam and learn some particulars of its construction and the part it played in the work of cultivating the surrounding country.

In a country like South Africa the importance of such a work cannot be overestimated, as by irrigation alone can the vast territories now lying barren be brought under the plough. At present the main industry of the colony is sheep farming, the Dutch farmers being of too indolent a nature to attempt on any scale the far more remunerative occupation of cultivating grain. In some places one does see a half-hearted attempt has been made in this direction; but the crops are scanty, and wither away under the fierce heat of the sun; and after a few more equally futile attempts, the cultivation of grain is abandoned as unprofitable, and the soil and climate are condemned for the failure. But the real reason is the want of water, a want that could easily be remedied if the agriculturist would only recognise this, and stir himself to artificially provide the moisture lacking in the soil.

That splendid crops of all kinds of grain can be easily and profitably raised in South Africa by the aid of irrigation is forcibly impressed upon one by a visit to Mr. Smart's estate. The first thing I noticed was the substantial-looking stacks of corn; and secondly, the large area of land under cultivation. The soil was of a rich red colour, and had been thoroughly ploughed, each field being connected by channels with the main lead from the dam. The main lead itself is about five feet in depth and four feet wide, and a considerable amount of labour must have been expended to construct it. Mr. Smart was kind enough to personally conduct me to inspect the dam, and on the way gave me many interesting details concerning its construction and the benefits that have accrued from it. The first thing that struck me was the ingenuity displayed in choosing a place, the geographical features of which so entirely lent themselves to the purpose to which they had been put.

Situated in the midst of the hills, a couple of hundred feet above surrounding plains, the dam terminates in a narrow neck, across which the great barrier has been built. Surrounded on all sides by rugged hills, the great expanse of water stretches back for fully six miles in

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length, the greatest breadth at any part being one and a half miles, and the average depth eight and a half feet. The great wall of the dam is seven hundred feet in length, and thirty-seven feet high, and is composed of solid beaten earth faced with stones. So completely and carefully was it constructed, that men were employed to do nothing else but pick up any, even the smallest, pieces of wood that might be found mixed with the soil used in the construction. The blasting operations were also extensive, many tons of rock having to be removed from the hills on either side of the gap before the ends of the wall could be properly built in. The water is distributed by two fourteen-inch pipes leading into the main irrigating channel, and the amount of water escaping is regulated by locks connected with the pipes, the distribution to the auxiliary branches from the main channel being controlled by a series of lesser locks. The entire supply is rain-water, drained from the surrounding hills for twenty miles away; and though no river or stream goes to swell its waters, the dam filled in less than twenty-four hours after its completion. In shape, the dam rather resembles a broad-toed horseshoe, on one side having two small bays. The entire cost of construction was £9000, which amount was advanced by the Government, under whose supervision the work was carried out. As to the success of this enterprise, the following figures will speak for themselves. Before the construction of the dam, the cultivation in the vicinity was practically nil, the whole country being given up to sheep farming. Since the dam has been in use, five hundred acres have been brought under cultivation, and the average yield of grain per acre has been 1200 lbs., the profit being so great, that in three years nearly the whole of the amount (£9000) advanced by the Government has been repaid. The possibilities of this work are unending and the capacity inexhaustible; already five hundred acres of veldt have been reclaimed, and are now yielding remunerative crops. Mr. Smart is willing to supply any of the surrounding farmers with water on easy terms, if they care to become disciples of the new system, a system that will soon change the country from a barren waste into a fertile and luxuriant garden, adding incalculably to the wealth of the colony, and ranking How Water among the grain-bearing districts of South Africa.

THE NORWEGIAN NORTH POLAR EXPEDITION.[1]

WHEN Dr. Nansen returned from his remarkable drift in the *Fram* across the ice-laden Arctic Ocean, he delighted the public by his lectures, and by a thrilling narrative of his adventures published in two handsome octavo volumes. At the same time he promised to supply as soon as possible detailed information regarding his scientific observations in various branches of science, for the benefit of the more learned world. This promise he has now in part fulfilled by the publication of

[1] *The Norwegian North Polar Expedition*, 1893-1896: Scientific Results. Edited by Fridtjof Nansen. Vol. I. London: Longmans, Green, and Co.

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the first volume of a series of memoirs on the scientific results of the Norwegian North Polar Expedition. The get-up of the large quarto volume now before us is in every way excellent, with regard to paper, type, and illustration. The text is entirely in English, and is printed in Christiania.

In a preface Dr. Nansen says he has been fortunate enough to secure the co-operation of some of the first authorities in the various branches of science for the study of his collections and observations, and he estimates that the whole publication will extend to about five or six volumes, which it is hoped will be completed in about two years. In order to place the various memoirs before the scientific world at the earliest possible date, they are to be issued, as was the case with the *Challenger* Reports, without regard to any systematic sequence, and as soon as there is sufficient material to fill a volume. Shortly after Dr. Nansen's return the Norwegians formed by public subscription what has been called the Fridtjof Nansen Fund for the Advancement of Science, and the council which controls this fund has supplied the necessary means for the publication of the scientific results of the expedition. These reports promise, both in appearance and contents, to be in every way worthy of the Norwegian nation, and the zealous and devoted work of Dr. Nansen and his brave companions on board the *Fram*.

In addition to the preface, this first volume contains five memoirs. The first deals with the *Fram*, and is from the pen of Mr. Colin Archer, her designer and builder. The use to which this vessel was to be put was so totally different from that of any ordinary ship, that it was in vain to seek a guide in any of the established rules and regulations for shipbuilding. The builder was therefore thrown on his own resources, and had to be guided by his own judgment and experience. After giving a brief description of the *Fram*, her design and construction, and pointing out some of the details in which she differs from the general run of ships, Mr. Archer states that, when the *Fram* was examined and carefully surveyed for her second expedition, not the smallest sign of straining could be discovered in any part of the vessel. The *Fram* thus started on her second voyage to the Arctic under Captain Sverdrup without any repairs being necessary to any part of the original hull, beyond some caulking. This is the best evidence that the expectations of her designers were completely realised, and that she would have come triumphantly out of even more severe trials than those to which she was exposed during her remarkable voyage.

The second memoir is by Dr. Pompeckj and Dr. Nansen on the Jurassic Fauna of Cape Flora, Franz Joseph Land, and runs to 146 pages, with two plates and twenty-one illustrations in the text. Dr. Nansen gives an account of the geological structure of Cape Flora and its neighbourhood, in which he does full justice to the work of Dr. Kœtlitz, of the Jackson-Harmsworth expedition, in the same area. Dr. Pompeckj describes and illustrates the fossils found at Cape Flora, and discusses the stratigraphical results and palæographic history of Franz Joseph Land. A fauna of at least twenty-six forms is indicated by Dr. Nansen's collections from the Jurassic sedimentary rocks at Cape Flora, but Newton's description of the collection of the Jackson-Harmsworth expedition shows that the abundance of Jurassic animal fossils is greater than would appear from the material collected by Dr. Nansen. These fossils from the most northerly Jura region of the earth show, on the whole, distinct affinities to the Central European Jura, and are of great interest in connection with Neumayer's theory of climatic zones in the Jurassic period, a theory which now appears to be untenable.

In the third memoir, which occupies twenty-six pages, illustrated by two plates and six illustrations in the text, Professor Nathorst, the great paleophytologist,

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describes and illustrates the fossil plants found near Cape Flora, and discusses their geological age. These plant-bearing strata all belong to the Upper Jurassic. Professor Nathorst regards them as younger than the Oxfordian beds, and refers them to a horizon somewhat older than the Wealden, which latter deposit he regards as belonging to the Jurassic period and not to the Cretaceous.

In the fourth memoir, which extends to fifty-four pages, Dr. Collett and Dr. Nansen give an account of the birds observed during the voyage, with dates and localities of their occurrence, accompanied by interesting notes on their food and other biological data. The paper is divided into four sections :—(1) Along the Siberian coast in the autumn of 1893 ; (2) the first summer in the ice, 1894 ; (3) Nansen and Johansen's sledge journey, 1895-6 ; (4) the two last summers on board the *Fram*, 1895-6. It is stated that in the Arctic Ocean between lat. 81° and 83° N., there is an abundant bird-life, doubtless consisting principally of young birds, which spend the summer months here, in and near the open channels in the ice. Among the specimens occurring here, sometimes in great numbers, may be named *Cepphus mandti*, *Alle alle*, and *Pagophila eburnea*. A few specimens of waders (*Ægialitis hiaticula* and *Crymophilus fulicarius*) were also found in these northern latitudes, as well as a specimen of *Xema sabini*. The first bird seen during the spring of 1894, when the *Fram* was approaching the more northerly part of her drift, was a gull (probably *Pagophila eburnea*) which appeared on May 13th ; from this time birds were seen now and again until the middle of August, but after August 23rd, when all the channels and lanes about the ship began to freeze up, no birds were seen till May 14th of the following year. There is a detailed description of the little-known roseate gull (*Rhodostethia rosea*), illustrated by two beautifully coloured plates.

The final memoir in this volume deals with the Crustacea, and is the largest, being illustrated by no fewer than thirty-six plates. It is written by Professor G. O. Sars, a brother-in-law of Dr. Nansen, and probably the best-known authority on this class of animals. Professor Sars states that by far the greater number of the marine invertebrate animals brought home by the Norwegian North Polar Expedition belong to the Crustacea, and, though there is comparatively little to report of the other classes, Professor Sars intends subsequently to give a short account of the other marine invertebrates obtained. Only one bottle in Dr. Nansen's marine collection contained true bottom-living animals, and these were taken by means of a trawl ; all the other samples were procured by the tow-net, and, therefore, contained exclusively pelagic animals, chiefly Crustacea. This peculiar character of the marine collections is to be explained by the fact that Dr. Nansen adopted the generally accepted view that the north polar basin was a quite shallow sea, consequently the *Fram* was not provided with apparatus for carrying out deep-sea investigations ; indeed, it was only after making up from the wire ropes of the *Fram* a provisional sounding-line of thin steel wire that he was enabled to take soundings in the deep sea over which the *Fram* drifted. Professor Sars informs us that a preliminary examination of the deposits brought up in these deep soundings revealed scarcely any traces of organisms, and he therefore concludes that there is very little animal life on the bottom in the greater depths of this part of the Arctic Ocean. From the foregoing statements it thus appears that the *Fram* expedition is not likely to add much to our knowledge of the nature and distribution of the deep-sea fauna. However, the peculiar Amphipod, *Cyclocaris guilelmi*, was found several times clinging to the sounding-line at only a short distance above the water-bottle when hauled up from depths of 500 and 1000 metres. The imperfect development of the visual organs in this form, and in some of the other pelagic animals observed, points to an abyssal habitat, and

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indicates that it is not quite safe to conclude that there is no abyssal fauna in the Arctic Ocean around the pole.

On the other hand Professor Sars states that it is a remarkable fact that the more superficial strata of the Arctic Sea, though almost perpetually covered by a layer of ice, in which temporary openings occur in the shape of channels and lanes, contain an abundant pelagic life at all times of the year, and even to the most northerly latitudes. These organisms appear to descend to considerable depths; in many cases the tow-net was lowered beyond 200 or 300 metres, and as a rule the hauls at these depths were considerably richer than those obtained near the surface of the sea. The pelagic animals here referred to are chiefly Crustacea, and of these again the Copepoda, belonging to the Calanoid group, are predominant, having been taken in nearly every haul, and in considerable numbers, along the whole rout of the *Fram*. Professor Sars points out that it is not a little surprising to find rather abundantly represented among these Calanoids some characteristic forms well known to him from the deep fjord basins of the south and west coasts of Norway, where they are met with only in depths of more than 100 fathoms. He is of opinion that the bulk of pelagic animals found in the north polar basin are derived from the west, through the Atlantic current flowing in beneath the superficial Siberian current. He says:—"I think that the Siberian current is of great importance in conveying a constant supply of nourishment to the pelagic animals of the north polar basin This nourishment consists of microscopic algæ, chiefly Diatomeæ, which are found to abound in the superficial polar water of the Siberian Sea, though gradually diminishing in quantity westwards, apparently owing to their being largely fed upon by the various pelagic animals. Indeed, without such a constant conveyance of nourishing matter, there could be no such rich animal life in the polar sea." This view, although interesting, is not likely to be accepted by many oceanographers without very important qualifications.

Professor Sars calls attention to the remarkable fact that forms which have hitherto been regarded as quite southern in distribution are also represented in the polar sea. Thus at about the centre of the polar basin traversed by the *Fram*, he found a specimen of a Calanoid, differing conspicuously in external appearance from all the other forms, and easily recognisable as a species of the genus *Hemicalanus*, a genus only known hitherto from the Mediterranean and tropical parts of the Atlantic and Pacific Oceans, never having been met with in the Norwegian seas, nor off the Atlantic coasts of Europe. Again, in the sea to the north of the New Siberian Islands, two species of the genus *Oncæa* were found in great abundance, both of which Professor Sars has been able to identify with perfect certainty with species recently recorded by Dr. Giesbrecht in the Bay of Naples. In one sample, Professor Sars succeeded in picking out some specimens of a perfectly hyaline Copepod, at once recognisable as a species of the highly remarkable genus *Mormonilla* of Giesbrecht, and he says—"Only two species of this genus have hitherto been recorded, and both of them were found in the tropical part of the Pacific, south of the equator. The polar form so closely resembles one of the two species described by Dr. Giesbrecht, that I should have been much inclined to identify the two forms, were it not that the great distance between the occurrences seems to forbid such an identification." This statement of Professor Sars is an interesting illustration of a practice among naturalists, pointed out by Sir John Murray, that a great geographical distance separating the places where specimens were collected is often considered a sufficient reason for laying great stress on some slight variation, and creating a new species. The probability is that the species here referred to are in most cases

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organisms having a nearly world-wide distribution in depths of 300 and 400 fathoms, which are occasionally brought towards the surface through ascending currents. The very close, apparently genetic, relationship between two polar species of Amphipods (*Pseudalibrotus*), described in this memoir, and those occurring in the Caspian Sea, is a remarkable instance of distribution which seems fully to corroborate the correctness of the view of geologists as to a direct communication in olden times between this isolated basin and the north polar sea.

Dr. Nansen is to be heartily congratulated on the publication of the first volume of his reports on the scientific results of the Norwegian North Polar Expedition. Among the forthcoming memoirs is one by himself on the oceanography of the north polar basin, which will be looked forward to with special interest.—*Scotsman*, April 2, 1900.

GEOGRAPHICAL NOTES.

On the possibility of obtaining more reliable Measurements of the Changes of the Land-Level of the Phlegræan Fields. By R. T. GÜNTHER, M.A., F.R.G.S., Magdalen College, Oxford.

IN the present communication it is the purpose of the author to draw attention to a locality in which changes in the relative level of sea and land have occurred so recently, so rapidly, and on such a scale as to make it possible to obtain approximately accurate measurements with regard to those changes.

Although geological evidence concerning the elevation and subsidence of larger or smaller land-areas is everywhere abundant, yet instances are rare in which such earth-movements have occurred within the historical period, and have also been attended by such circumstances as to make their accurate measurement feasible. It is therefore important that every locality where the magnitude and duration of earth-movements can be estimated with a fair degree of accuracy should be carefully investigated.

The earth-movements which are here considered were probably not sudden enough to be regarded as earthquakes, although they occurred in a volcanic region subject to them, but they were probably rather of the nature of those slow secular earth-movements which have been observed in Greenland, Spitzbergen, and at numerous places around the Baltic and Mediterranean basins and elsewhere.

In no case is the evidence of change of level within the historical period more conclusive than that afforded by the classical case of the so-called Temple of Serapis, near Pozzuoli on the coast of the Phlegræan Fields. The columns of this temple, bored by *Lithodomi*, are standing memorials of the fact that the land upon which they were erected has since sunk some twenty feet, has remained submerged for a considerable period, and has again risen, although not to its former level.

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In other words, there is evidence that the shore upon which the ancient Romans walked was at a higher level above the sea than the present shore. But, so far as I am aware, there are no authoritative statements as to what the land-level with respect to the sea-level actually was in Roman times.

Now there are at the present day numerous ruins of buildings of undoubted Roman construction which are at present submerged beneath the waters of the Bay of Naples. It is more than likely that a careful investigation of them would enable us to ascertain what the land-level must have been at the time of their construction, and what must have been the configuration of the coast-line.

All along the Cape of Posillipo and in the Bay of Baia it is possible in calm weather to make out the walls and rooms of houses now submerged to a depth of several feet. In some places the houses extend for a considerable distance in straight lines, as if they had been built along the two sides of an ancient street. Such a line of houses is shown in the old map of Pozzuoli prepared by Bulifon in 1696.

No doubt many of these submarine works were always beneath the water, and were the foundations of piers or harbour works, or perhaps even of fish ponds of the Romans. Horace, in at least three passages in the Odes (*Od.* ii. 18; iii. 1; iii. 24) alludes to the fact that his wealthier contemporaries were in the habit of erecting their seaside residences upon piers artificially built out into the sea.

But there is every reason to believe that most of the submerged buildings mentioned above were originally sub-aërial. This is indicated by the character of the masonry (the *opus reticulatum* was not employed for submarine work), by flights of steps continuing far beneath the surface, by submerged doorways and by passages cut in the solid rock, but lined with masonry, and now full of water. Further evidence of the subsidence of the land-level, were any needed, is afforded by the numerous partially submerged artificial caves and quarries which have been artificially cut out of the sold tufa and of which the floors are now eight or more feet beneath the surface.

If a careful survey be made of these submerged buildings, a very fair estimate of the change of level which has occurred since Roman times might be arrived at. For this purpose it would be necessary to construct a plan exhibiting the relative positions of the buildings and of their depth beneath the surface. From an examination of several of the submerged houses, I feel convinced that it is still possible to collect such a number of independent facts concerning the ancient sea-level as will enable us to settle the Roman coast-line of the Phlegræan Fields with considerable approximation to the truth. At the same time it is important that the examination of the ruins should not be deferred too long, for every winter storm helps in the work of their demolition. The erection of sea-walls to protect the shore at the present day, by covering up traces of old work, also makes the adjacent outlying masonry walls more difficult of interpretation.

The Duke of the Abruzzi's Arctic Expedition returned to Norway on September 5th, having reached the highest latitude on record, 86° 33′ N., Nansen's most

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northerly point having been 86° 14′. The following particulars are given by the correspondent of the *Daily Chronicle* :—

The *Stella Polare* is a small vessel, about twenty yards in length, and was originally a whaling-boat. She had previously been used by Nansen in his Greenland expedition. She was specially fitted out for the present purpose under the personal supervision of the Duke, who looked after the minutest details, even the food placed on board passing through his own hands. Parts of the vessel were remodelled with a view to resisting the impact of the ice. She remained a sailing craft, but small engines were introduced with a speed capacity of five miles an hour, so that progress could be made in any weather. The engines were also intended for heating purposes.

The ship was divided into two main portions, the crew occupying the fore part, while the cabins were situated aft, the dogs being accommodated on deck. The saloon was most comfortable and well-appointed, if not of great dimensions, and was provided with pictures, a musical box, and a splendid library of scientific and other books. The saloon was a kind of common living-room, in which most of the work, except actual navigation, was performed.

Sufficient provisions for three years were stored on board, so that if the expedition had to go short of food, as reported, some untoward accident must have happened. The provisions were conveniently packed in small boxes, one of which could easily be carried by one man, and were stored in such a way that in case of necessity the less important supplies could be dispensed with or the cases thrown overboard. On the stern of the ship was the white Layoya cross on a red ground, and the words *Stella Polare*. The crew comprised Captain Everson and ten Norwegian sailors, who were selected as best adapted to the requirements of the Arctic climate, two Italian seamen of exceptional physical strength to look after the sleighing arrangements, and four Alpine guides. The latter were a new feature in enterprises of this kind, and they proved a great success, although Nansen himself expressed the opinion that they would be practically useless, the character of the Polar ice being quite different from that found in their native mountains. The chief of the guides, Pettignex, is one of the best-known and most experienced in the Val d'Aosta. The Duke's colleagues were Captain Cagni, of the Italian Marines, and a Piedmontese, and Dr. Count Quirini, who belongs to an ancient Venetian family. Both these gentlemen accompanied the Duke throughout his Alaskan explorations, which have been recently described by Dr. Filippi.

The following account of the expedition is supplied by an Italian correspondent who witnessed the start of the *Stella Polare* from Christiania :—

The preparations were commenced early in the winter of 1898, when the Duke proceeded to Christiania, and had long conferences with Nansen, who freely and generously offered his advice and practical help. The Duke returned to his home to bid farewell to his family, and returned to the Norwegian capital in February 1899, from which time till he sailed he was busily occupied. Great attention was paid to the scientific part of the expedition, and when all was ready Nansen expressed his hearty approval of the equipment generally. I had several interviews with Nansen during my stay of three weeks in Christiania, and heard his views of the whole affair. The ship was largely rebuilt by Mr. Archer, well known as the creator of the *Fram*.

From Christiania the *Stella Polare* proceeded to Archangel. She had a most enthusiastic send-off from the capital, and was saluted by the fort. At Archangel 125 Siberian dogs were shipped, these having been specially collected for the purpose by the Tsar. From the coast of Norway the Duke made direct for Cape Flora, intending to winter in the north of Franz Josef Land, and to make

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a start for the Pole in the spring. Indeed, the route selected was practically that taken by Nansen.

On the way the Wellman expedition was met coming home, and it brought news of the welfare of the Italians. Since then nothing had been heard of the *Stella Polare* until the announcement of her return to Tromsö long before she was expected. The *Hertha* had previously been despatched to obtain tidings of the Italian explorers, but had failed to discover them.

The principal end the Duke of the Abruzzi had in view was to penetrate the Arctic region farther even than Nansen had gone. They were, of course, to go as far as possible in the ship, and then undertake journeys by sledge. As far as can be gathered the expedition developed exactly on the original plan, but unfortunately two important mishaps occurred. It would seem that the vessel was unable to withstand the pressure of the ice, and the winter quarters had to be moved to an improvised tent, which considerably reduced the personal comforts which Nansen was able to enjoy in the more robust *Fram*. The Duke naturally regarded his boat as safe from accidents of this kind, and Captain Everson was considered an expert in Arctic navigation.

The second mishap was the loss of a sleighing party which never returned. It included the two Italian sailors who had charge of the special waterproof boat designed for crossing small extents of open water, and a Norwegian machinist. The Duke lost two fingers through frostbite, and other members of the expedition suffered in a similar way. It would seem that the Italians stood the cold better than the Norwegians.

NEW BOOKS.

A Monograph of Christmas Island (Indian Ocean). Physical Features and Geology. By CHARLES W. ANDREWS, B.A., B.Sc., F.G.S. With Descriptions of the Fauna and Flora by numerous contributors. Map and Illustrations. Printed by order of the Trustees of the British Museum (Natural History). London, 1900. Pp. xiii + 337.

This highly interesting and instructive volume, communicating the results of a scientific exploration of Christmas island, is published under the auspices of the Trustees of the British Museum, who had permitted Mr. Andrews, a member of their official staff, and eminent both as a geologist and a zoologist, to proceed to that island with a view to examine its structure and natural productions. The funds, however, which were necessary to defray the expenses of the undertaking, were not supplied by the Museum, but by the generous munificence of the President of our Society, Sir John Murray, whose devotion to the cause of scientific research is known the world over. The island, which has an area of forty-three square miles, lies remote from any other land, rises where the ocean has a depth of more than three English miles, and has the distinction of having been, till quite lately, the only tropical island of any large extent that had never been inhabited by man, either savage or civilised. These peculiarities combined to render the island an object of great interest to Sir John Murray, and stimulated his desire that it should be subjected to a thoroughgoing scientific scrutiny, before its occupation by man should modify its existing condition due to the sole agency of nature. It lies in S. lat. 10° 25′, and E. long. 105° 42′; is 190 miles distant from Java, the nearest land to the north, and 550 miles from Australia to the south-east. Rising sheer upwards from profound depths of the

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Indian Ocean to a height of considerably more than 1000 feet above the sea-level, it is completely covered over with a rich tropical vegetation, and is the home of several kinds of animals, some of which form distinct species. The island was mapped for the first time in Holland in 1666 under the name of *Moni*, but it is not known who discovered it or who gave it either that name or the one it now bears. The first description of it came from the pen of that old navigator and buccaneer, Dampier, who touched there in 1688. He notices the great depth of the sea around and close up to the shore, the steepness of the cliffs towards the south and south-west, the sandy bay on the north side, and the number of its booby and frigate birds, both of which proved good for eating. In 1866 an anchorage was discovered in the sandy bay mentioned by Dampier, and here the white shingly beach forms now the site of a small settlement. An exploration of the interior was first effected in 1867 under Captain Aldrich of H.M.S. *Egeria*, whose men cut a way up the cliffs to the highest point of the island. In consequence of these discoveries it was annexed the following year to the British crown.

His examination of the geological structure of Christmas island has led Mr. Andrews to the conclusion that it is an atoll which must at one time have consisted of reefs and islands very like those of the atolls regarded as typical, and that its basis is almost certainly a volcanic peak, on the summits and sides of which, have been accumulated great deposits of tertiary limestone, interstratified in some cases with erupted matter. His observations have led him to the inference that the island, though originally an atoll, could not have been formed in accordance with the requirements of the Darwinian theory. The summits of some of the higher hills have been found to be covered with thick beds of lime phosphate formed by the deposit of guano on the limestone crests of the islands, before they became unified into Christmas island. This source of wealth has already been attacked—a commercial company having been formed to work the phosphates under a lease from the British Government, which charges rent, and royalties on its exports.

The fauna of the island are but few, and derived from the Sunda archipelago, of which it is thought to have at one time formed a part. Some of the fauna and most of the land birds are now distinct species. The work is illustrated by twenty-two plates, some coloured, a map, and numerous reproductions of photographs, in the text. The monogram will be highly appreciated, especially by naturalists, as it depicts a sphere, where for age after age, nature has worked her will, without any of her processes having ever been disturbed by human agency. Mr. Andrews and the members of the Museum staff, who so ably assisted him, have rendered a very valuable service to science.

Our Stolen Summer: the Record of a Roundabout Tour. By MARY STUART BOYD. With 170 Sketches by A. S. BOYD. Edinburgh and London: William Blackwood and Sons, 1900. Pp. 392. 18*s*.

The title of this book is happy, and chatty is the style. There is the authoress, with an artist whose sketches are admirable, and a boy. With the last notes of summer Britain is left behind, and the voyagers turn towards the Orient. Marseilles and Naples are soon passed, and one is at the gate of the East, obtaining a glimpse of Colombo. Australia is skirted, and New Zealand is reached, where a pause is made, when we learn much about the Maoris, gold-mining, and ostrich-farming. Once more we are borne to the Southern seas, and Samoa, with its entanglement, fills a space, and then we are hailing for America and home.

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Our geographical knowledge is not much added to by the volume, but the snapshots of life we obtain, by pen and pencil, in the Old World and the New are specially interesting and valuable. The views expressed of men and matters might be controverted, but they are the writer's own, and she is entitled to them. It is a well-written record of a trip, and the glimpses of humour, like the artist's sketches, make it refreshing.

Der Kilimandjaro. Reisen und Studien von Professor Dr. HANS MEYER. Mit 4 Tafeln in Farbendruck, 16 Tafeln in Lichtdruck, 20 in Buchdruck, 2 Farbigen- originalkarten und 103 Textbildern. Berlin: Dietrich Reiner (Ernst Vohsen), 1900. Pp. 408. Two Appendices and Index. *Price* 25 *M.*

Professor Hans Meyer considers this really magnificent volume as a jubilee offering, and an offering worthy to be called such it certainly is.

On the 11th May 1848 the German missionary, Johann Rebman (sent to East Africa by the Church Missionary Society, if we mistake not), on a journey from Mombasa towards the west, discovered Africa's wonderful snow-crowned mountain —the now celebrated Kilimanjaro.

Fifty years later, in 1898, Professor Meyer made his third journey to the mountain and completed its survey.

The result is highly satisfactory, for not only have we a truly scientific description of the mountain and its surroundings, but the book is so splendidly illustrated that it forms a perfect album of views most excellently produced.

The book does not claim to be a book of travel, although our author has written it as if it were such, solely, however, in order to carry his reader along with him, and as he thinks and we think, he is right to lead on step by step from one point of interest to another.

Only two chapters form an exception to this rule—one on the geology and the other on the glaciers of Kilimanjaro.

The professor has sought throughout to search for the original cause of the appearances now seen, and says that if here and there he has fallen into error this will only serve to stimulate further investigations, and these will all go to the sum of our knowledge and of the truth.

The proper time of the year to visit Kilimanjaro is from the middle of August to the beginning of October, and this hint is of real value to those who, stimulated by this very fascinating volume, seek to follow the professor's footsteps.

We may note in passing a point which is of interest. Writing of the German and British railways towards the mountain, he says that the German railway stations are built of hewn stone and are seemingly intended to stand till doomsday, but the line itself—the engines and carriages are most inferior; the exact reverse obtains on the British line—the line itself is well constructed and little or no expense has been wasted on stations, which practically are of no importance on such a railway.

One is rather tempted to enlarge on our author's views respecting railways, and on his comparison between the British and German East African protectorates, but we will only say that in his opinion Britain builds the Uganda railway for political purposes, and that he thinks that unless gold or diamonds are found south of the Victoria Nyanza a railway from Dar-es-Salam would be a commercial failure; also he considers that the progress of the German protectorate is very superior to the British. Those interested in this subject should read Chapter VIII.

A full description of Kilimanjaro is for the first time before us. Our late Honorary Fellow J. Thomson, Von Höhnel, and J. W. Gregory have all worked in

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the district of which this massive mountain may be said to be the centre, but till now no one has given us such a graphic, detailed, and scientific account of its wonders.

Clearly written, not diffuse, and free from technicalities, this book, although of the greatest value to the student, will be read by all with comprehension, pleasure, and interest.

With the geological details and the theories which the author puts forth this is not the place to deal, but he certainly gives good grounds for his own views as to the formation of volcanoes in general, and Kilimanjaro in particular. His views on glaciers are also most valuable.

No words of praise are too great for the beauty and value of the illustrations, and the publisher is to be congratulated warmly on his share of the work. The price of the book is remarkably low, and even as an album the volume is well worth possessing.

The author can surely look back upon his work with every satisfaction.

A History of Aberdeen and Banff. (*County Histories of Scotland.*) By WILLIAM WATT. Edinburgh and London: William Blackwood and Sons, 1900. Pp. xv + 438. *Price 7s. 6d. net.*

This volume, which is one of the series of County Histories of Scotland, merits high commendation on account of its thoroughness and care, and it is also characterised by ease and fluency of expression. The author has availed himself of legend and tradition for the materials of his history, as well as of authentic records and statistics, but he has not failed to give to these respective elements their proper weight and place, and the result is a most exhaustive treatise. He begins with the Romans, takes us forward to early and little-known Saints, follows on with the incursions of Scandinavians and the dim mediæval figures of Macbeth and his contemporaries, till at last the more solid, if still somewhat nebulous, ground is reached of the early chroniclers and bards who wrote and sung of Bruce and Comyn and the red field of Harlaw. He makes use of burgh charters and records, which show how civilisation gradually ousted barbarism and feudalism, and illustrate how one great family—the Gordons—justified their Head's title of "Cock of the North" by practically holding in their hands for a long period the destinies of this important part of Scotland, and this portion of the history has all the picturesqueness of romance, with the advantage of being presumably true to fact. Readers of this *Magazine* will find interest in an old map of Aberdeenshire by the learned "Parson of Rothiemay," and it is also satisfactory to note that there is a serviceable index to the book. The multitude of remarkable people enumerated in the volume who have sprung from or been connected with these counties will surprise the reader who has not had the advantage of deriving his origin from them, and who may therefore be unfamiliar with the local proverb, "Tak' awa' Aberdeen and twal' mile roun' about, and whaur are ye?"

Romantic Edinburgh. By JOHN GEDDIE. London: Sands and Co., 1900. Pp. xii + 326. *Price 6s.*

The author of *Romantic Edinburgh* was probably not himself aware of the dubiety of his title. It might mean—with the author happily it does mean—that all Edinburgh is romantic; or it might have meant, as happily it does not mean, that the author had selected by some new literary cyanide process those portions of Edinburgh that were still worthy of the golden words of the Wizard

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of the North. Mr. Geddie is not eclectic but inclusive. He tabooes nothing. Just as when Mr. Henley, in one of his boldest London lyrics, sings the sunlit glories of the Strand as "golden all golden," so Mr. Geddie practically proclaims that Edinburgh is, to him at least, romantic all romantic. Not to exaggerate his office, he has, in this compact octavo, played the part of the city guide as it has never been played before. This office, if you take it even in the guise of a badged beadle, is not so menial as it looks. It implies interest, study, memory, tact. In this present work the author has displayed that detailed interest which comes of long familiarity with details, that study of older authorities which no historian can neglect, that memory which is the natural issue of keen personal interest, and that tact which is developed by having to deal in many ways with many types of character.

The writer of the present notice has lived in Edinburgh as long as the writer of *Romantic Edinburgh*. He knows its aspects in all seasons; he knows its aspects at all hours. But a rapid reading of the little volume now before him stirred the writer to go forth again at unwonted hours to see things he had seen with refreshened eyes, and things he had not seen with wonder how he had missed the seeing of them. Nor did he trust to himself: he took into counsel an old antiquarian friend; and he found that his old antiquarian friend had been purloining hours from more serious business for the sake of verifying the accuracy of assertions made about this close and that by the author of *Romantic Edinburgh*.

As we have already said, Mr. Geddie regards all Edinburgh as his own romantic town. There is a sense in which everything is romantic; but the "romances," whether they come from nameless bards of Greece, from dubious troubadours, or forgotten ballad-makers of Scotland or Scandinavia, are romantic in virtue only of their dealing directly with the great facts of life—with life so illumined by love, pain, effort, failure, hope, hate, despair, defiance, conflict, death. And the romantic touch in Mr. Geddie's book is that he reads into the stone and lime—the streets and closes and stairs—of Auld Reekie those various elements of the life of the men and women to whom the town was dear long ere he or any of his readers had played the limpet on some bit of accidental vantage-ground for business or pleasure.

As is implied by what we have already said, the method of the book follows the lines of topography rather than of history. Taking his stand on the North Bridge, he uses all his imagination and skill to call up before us the appearance of the "Hollow of the Winds" which is the "chief channel by which the east wind —Edinburgh's great enemy since her English invaders come no longer to raid and burn, but as pilgrims to the beautiful—breaks in upon her streets and squares. By this way steals in the main body of the fogs and 'haars' out of the North Sea, that choke the valley, blot out of sight the towering houses of the Old Town, or spread a grey veil thro' which their outlines loom vague and gigantic like a city of cloudland." By means of a few strong strokes we are at once put into touch with the dominant relations of the city, both natural and artificial, at various periods of its evolution; and are ready with a prepared mind to follow our guide as he takes us into closer scrutiny of the more interesting portions of Romantic Edinburgh.

The very titles of Mr. Geddie's chapters show at once the practical way in which he has schemed his work:—"Nor' Loch and North Bridge; the High Street and St. Giles; Old Hie Gait Life; from the Tron to the Castle Hill; the Lawn Market and the Castle Hill; the Castle; the Netherbow precincts; the Canongate; Holyrood; the Queen's Park; Round the Flodden Wall—the Cow-

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gate; Round the Flodden Wall—the University; Round the Flodden Wall—the Greyfriars and the Grassmarket; Newington and Grange; From Morningside to the West Kirk; the New Town—Princes Street; the Calton; George Street and its environs; the West End; the Water of Leith; Leith Port and Burgh; Portobello." Wherever he takes us the author is master of his materials—materials collected by the reading of many books, the meeting with many men, and the perpetual use of a rare faculty of seeing for oneself. At every turn we are struck by the appositeness, at times by the unexpectedness, of the literary allusion; by the originality and directness of the literary phrase. The Castle Rock is Louis Stevenson's "most satisfactory crag in nature, a Bass Rock upon dry land." The "Craig-end of Calton" now bears what Mr. Geddie sees as a "sheaf of prison towers." He looks on the railway station as a "spider's web of railway lines," and the Waverley Station is a living octopus which has spread out its "tentacles to seize and swallow the ground once occupied by the first Orphan Hospital, the original Lady Glenorchy's Chapel, and the Old Physic Gardens." The North Bridge itself recalls to him Lord Rosebery's epigrammatic description of it as "the foundation of the city's beauty." When he deals with the old howffs and drinking customs of the Edinburgh of Burns's day he presents us with Mr. Henley's picture of "a centre of conviviality, a city of clubs and talk and good fellowship, a city of harlotry and high jinks, a city above all of drink." As a special introduction to the High Street we have Carlyle's "a sloping high street and many steep side lanes covering like some wrought tissue of stone and mortar, like some rhinoceros skin, with many a gnarled embossment, church steeple, chimney head, Tolbooth and other ornament or indispensability back and ribs of the slope." "The nugget of cottages" at Broughton market, which represent all that is left of Broughton burgh, have, forlorn though they may be, "a quaint air of having wandered far from their own place," like Robert Fergusson's butterfly. At times Mr. Geddie's superabundant knowledge leads him to forget the ignorance of his audience. When he alludes jauntily (in his description of the Edinburgh Clubs) to the lost type of Lord Hermand, and the "mighty" Newton, he ought to have remembered that half at least of the very citizens of Edinburgh are as ignorant of Lord Hermand and the "mighty" Newton as of the early potentates of Assyria or Egypt. As for the average tourist—from America or elsewhere—we know what kind of entry will be made in the post-prandial notebook:—"Greatly struck by the fact that Newton—the illustrious Newton—not only visited Scotland (a question long in dispute), but that he took part in the "tavern gatherings, the Homeric feasts," etc. Mr. Geddie's index puts matters right by showing who the "mighty Newton" was. On the other hand the index-maker misunderstands his text when he makes Professor Blackie a "Rector" of the Edinburgh University; the index-maker has only read too rapidly. Mr. Geddie, however, must be held responsible for the statement that Nairne Lodge is in Portobello. His printer is possibly responsible for giving the University Library 150,000 instead of 250,000 volumes. But slips of this kind are to be expected in the first edition of a book which contains in every page a dozen opportunities of misstatement. For Mr. Geddie knows that time is short for the man who wants to get even a passing impression of the various elements that have made the Edinburgh of to-day; and he proceeds impartially from point to point.

Books about Edinburgh are not far to seek—ponderous, dry-as-dust quartos, brilliant studies on a fair-sized canvas, pocket booklets of various kinds—but we know nothing as yet accomplished which combines the best characteristics of the book of reference and the book to read as the *Romantic Edinburgh* now before us.

One thing we miss right through the volume. There are no maps. A re-

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duction of a coloured contour-map would have given effect to the geographical element, which forms the basis of the book. And from time to time an outline plan—ignoring the insignificant and emphasising the important—would have enabled the reader to follow the narrative with precision as well as with pleasure.

Practical Exercises in Elementary Meteorology. By ROBERT DE COURCY WARD, Instructor in Climatology in Harvard University. Ginn and Co., Boston, U.S.A., 1899. Royal 8vo, xiii + 200 pp. 53 Engravings.

Among teachers of meteorology Mr. R. de C. Ward has long held a prominent position in a country where special facilities are given in schools and colleges for instruction in both the practical and theoretical branches of the science. The work before us, while primarily prepared for pupils as an elementary text-book, can be advantageously studied by advanced students of meteorology. Part I. is devoted to non-instrumental observations, and the reader is gradually carried into the more technical principles of weather forecasting, including the comprehension of weather maps, isobars, gradients, cyclones and anticyclones, and many other branches of meteorology. The chapters dealing with temperature, pressure, and wind, are freely illustrated by a series of charts, showing in a graphic manner the distribution of weather over the United States under various conditions of pressure, etc. There are a few unimportant slips, *e.g.* on page 20, where mercury is said to be the liquid universally employed in barometers, no mention being made of the open-scale glycerine ones. Again, on page 23, aneroid barometers are stated to be graduated into inches and hundredths of an inch. We have never heard of such refined graduation being applied to aneroids, twentieths of an inch being the smallest division legible on dials of average size. In the sections devoted to "temperature," no mention is made of the "variability" of that climatic element. Taken as a whole the book is excellent, being well written and well printed on stout paper.

Cina E Giappone. (Il Celesto Impero e l'Impero del Sol Nascente.) E. VON HESSE-WARTEGG. Versione e riduzione con note originali per il Capitano Manfredo Camperio. Milano: Ulrico Hoepli. Pp. 535.

This work is not descriptive of the author's travels so much as of his impressions of the countries as a whole. For instance, among the headings of his chapters we find such titles as "The Administration of Justice"; "Life and Manners of Chinese Ladies"; "Chinese Theatres"; "Pig-tails"; "The importance to Europe of Chinese markets"; "Germany and Japan in China." Of more immediate interest at present are the chapters on the Secret Societies and on the Army. The author states that if the government at Pekin could suppress the secret societies it would regenerate the empire and form a loyal army; lives of European missionaries would be secure. The first mentioned is *Tien-ty-Wey* or Hung Society, which has ramifications in Padang (Sumatra) and even in Singapore. It exists for the purpose of overthrowing the Manchu dynasty and replacing the Ming. At Singapore the meetings are held among the swamps and are well guarded: strangers who have ventured too near have been murdered. The membership in 1887 is said to have included practically all the Chinese in Singapore, and with the lodges in Australia and America the total membership of the society runs into millions. It levies illicit taxes on gaming-houses and places of amusement. In 1817 the Pekin government moved against the Hungs, ten thousand of whom are said to have died in prison! The Hungs are stated to have driven the Sultan of Perak to place himself under British protection, and according to the author the Hungs were expelled from Singapore in 1880, but presumably they returned.

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Next in importance is the sect of *U-nei-Kian*, which massacred the missionaries in 1895. The members were for a time called vegetarians, but the threatened government of Pekin heard of their conspiracy against the Manchu dynasty, and defeating them, executed all those who would not eat flesh. These renegades, however, were in turn murdered by those of the sect whom the government failed to apprehend. Even among educated Chinamen the members of this sect are believed to have the power of simulating death while their spirits go out scouting. The third great sect of *Lo-hao-Uai* also exists to abolish the Manchu dynasty. To it is ascribed the outcome of the Japanese war. It is particularly strong in the army, and its members refused to fight, hoping for the fall of the Manchus after a disastrous campaign. The Mohammedans number twenty-five millions and have their secret society also. The novices have to drink soapy water to overcome the natural objection to swine flesh. These Mohammedans wear the "pig-tail" and dress of the other Chinamen.

The Chinese army is described at length as regards organisation, equipment, and efficiency. We may note that each viceroy levies his own army for his province, each viceroy having the powers of the Princes and Grand Dukes of the old German Confederations. Some keep their troops in a high state of efficiency comparatively; those of Li Hung Chang are specially mentioned, and generally those near the coast. The service is voluntary and recruits are plentiful, though the pay is wretched and there is no medical service for the troops. The officers for the most part are ignorant, as military arts are despised in China. The author has a higher opinion of the army generally and of the artillery in particular than most writers on China, and the army round the capital is stated to be well armed and in a high state of efficiency.

The Japanese section is in much the same style as the Chinese, but the Italian language seems to lend itself specially to descriptions of the Japanese and their women, whom the author, like all travellers in the country, found most charming. He has several chapters on them and their manners, with no less than eight drawings with details of their hair-dressing; pictures also of ladies having their tub *all' aperto*.

The whole work is handsomely printed, and the numerous illustrations, full-page and in the text, are well executed. Altogether a very readable book.

Tasmanian Rivers, Lakes, and Flowers. By A. S. MURRAY. With Facsimile Illustration in Colours by the Author. London: J. S. Virtue and Co., Ltd.; Australia: George Robertson and Co., 1900. *Price* £2, 2*s*.

A former work, published by the same author, entitled *Twelve Hundred Miles on the River Murray*, gives some excellent views of typical Australian river scenery, which is to a great extent flat and uninteresting. Mr. Murray has found in Tasmania, the subject of his present work, a much better scope for his artistic talent and descriptive powers. The lake and mountain scenery of this favoured island is bold and rugged, and the rivers for the most part rapid and picturesque, and in marked contrast to the sluggish streams of the neighbouring continent. The outline of the past history of the colony given in this work is very interesting, depicting as it does the characteristics of the native population, now extinct, and vividly describing the early days when Tasmania was a penal settlement, and cruelty, depravity, and suffering were rife. Convicts at that time (when sheep-stealing was a capital crime) were transported for what are now considered very minor offences, and the cruel and unjust treatment they received very soon turned the most well-disposed into hardened criminals and outlaws. Certainly Tasmania, though it has now settled down to be a thoroughly law-abiding and fairly

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prosperous colony, has been the scene of the most brutal and bloodthirsty crimes that have ever disgraced the British rule, both with regard to the ruthless shooting down and subsequent extermination of the unoffending natives, and, through the cruelty of the convict system, the turning of men into rebels and outlaws, who might, under kinder treatment, have become honest and industrious settlers. As an author, Mr. Murray has the gift (none too common) of condensing a great deal of information in a small space, and the reader may by an hour's perusal of this book acquire a better general knowledge of Tasmania, its history, scenery, flora, fauna, mineral resources, and sport, than can often be obtained in many hours from more voluminous works. Besides being an artist in his love of the picturesque, Mr. Murray is evidently an angler of no mean order, and his descriptions of fishing in this work will prove interesting to brothers of the craft. In regard to scenery, and the sport of fishing for acclimatised trout, Tasmania is unsurpassed in Australasia, with the one exception of the neighbouring islands of New Zealand, which thriving colony would furnish Mr. Murray with an interesting subject for a work of similar calibre.

India, Ceylon, Straits Settlements, British North Borneo, Hong-Kong ("British Empire Series"). With two Maps. London: Kegan Paul, Trench, Trübner and Co., Limited, 1899. Pp. xxvii + 536. *Price* 6*s*.

This book (marvellously cheap for its size and get-up) is composed of twenty-four essays, each (with two exceptions) by a different author. In their original form they were delivered as lectures at the Finsbury South Place Institute on Sunday afternoons between 1895 and 1898. Twenty of them deal with India—as a whole and in its individual provinces; four (one each) with Ceylon, the Straits Settlements, British North Borneo, and Hong-Kong. The authors are persons who have resided in and had personal experience of those regions—some as highly placed officials, others in non-official capacities which afforded opportunity for knowledge not less intimate, and others still as being themselves natives of India. As a whole the book may be said to comprise a more or less general account of the physical features and natural products of the various regions, of the ethnological and sociological characteristics of their inhabitants, of their history precedent and introductory to British rule, and of the methods of British administration, internal and external, with an estimate of its results and tendencies, so far as regards the development of the countries and the moral and material—industrial and commercial—interests of the native populations.

The essays differ in not only the relative importance and variety of their matter, but also the writers' grasp, insight, and power of accurate and fair presentation. We should say that some of the lectures were hardly worth reproduction in print, except possibly as gazetteer or encyclopædia articles. Others are important contributions towards the understanding of the regions described and the problems discussed. These were well deserving of permanence. The book, therefore, is unequal and somewhat patchy. It is not a book to be taken up and read through. But in it persons in search of an account of particular parts of the British Empire in the East, and of certain questions connected therewith, will find a number of informing and readable dissertations.

Of the twenty Indian essays, we may point out the following as together giving a lively impression of what India was before the British supremacy, of what that supremacy has done for it, and of the outstanding features in the character and condition of the people that furnish food for reflection and surmise as to the future:—"Our Great Dependency"; "Famine in India"; "The North-West Provinces of India"; "The Punjab"; "Central Provinces of India"; "The Native States of India"; "Industries of India."

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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE SIBERIAN RAILWAY.

By C. Raymond Beazley.

For any proper understanding of the Siberian railway, one must have some idea of the country it is intended to serve and has already so greatly benefited. This country is usually defined as the whole region north of the Ob-Aral water-parting, the Sayan mountains, and the main course of the Amur—that is, roughly speaking, all Asia north of the 50th parallel, mainly composed of four huge river-basins, those of the Ob, Yenisei, Lena, and Amur. The western, northern, and eastern boundaries are naturally fixed by the Ural mountains, the Arctic Ocean, and the Pacific.

Here, in a land comprising nearly five millions of square miles, there are naturally great varieties of climate, soil, and physical conditions. The name, in its modern and extended use, is quite artificial; the original *Siberia*, or *Sibir*, was a north-western relic of the once great Mongol Empire, situated in the upper valley of the Irtish and in the basins of its chief tributaries. It was the Russian conquest which stamped the term on the whole of Northern Asia; and it was mainly the absence of any organised state between the Irtish and the Gulf of Okhotsk (even on a par with the Tartar khanate of Sibir) which caused this strange "growth of a title."

From the Yenisei river, and still more from the Baikal basin, Eastern Siberia becomes increasingly different from the great plain of the west and the far north, being covered over nearly all its surface with mountains of respectable height, thickly wooded, and presenting a totally different appearance from the agricultural zone of Central Russia and South-western Siberia through which the railway passes as far as Krasnoyarsk. Again, looking at the country from north to south, three very distinct

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zones are to be found over a great part (and especially in the west) of this enormous area. First, there is the *tundra* or Arctic waste of the northern shore-lands, in winter a terrible desolation, and never at any season suitable for agriculture, but in summer affording a certain, though limited, pasture; and giving access to the northern sea-board, which, in places, is free from ice for some months in the year and has already developed a slender and intermittent communication with Europe. Secondly, there is the *taiga, urman,* or forest region, to the south of the *tundra*; a land of dense woodland, but available for agriculture, where clearings are made, about as far as the 60th parallel, the home of most of the fur and feather wealth of Siberia, and possessing in its timber, if properly and savingly used,[1] a great and permanent source of revenue. Thirdly, there is the southern belt of open agricultural country, in great part composed of the *black earth* region, a continuation of the *chernozoim* of Southern Russia, answering to the rich prairies of America, bordered on the north by the forests, and on the south by the waterless or barren steppes. It is through this agricultural region that the railway passes, and in this belt more than five-sixths of the population is to be found (five and a quarter millions out of six and a quarter). The native tribes, now mostly declining in numbers, are usually located in the forest zone; the great mass of the Russian emigrants live in the agricultural region, which has a climate and soil similar to that of South-central Russia, but somewhat drier. As we go eastwards and approach the Yenisei and the Baikal, a mountainous mining district becomes more and more prominent in the south. This region is thrown off from the Altai range, and it is hardly, if at all, inferior in mineral wealth to the Ural. It has long been famous for gold and silver; it has lately begun to attract attention for its copper, iron, and coal. This mineral wealth continues (though at present less exploited) in the south-central region between the Yenisei river and Lake Baikal, as well as in the cold mountainous country of the trans-Baikal province. To the minerals already mentioned must here be added tin, quicksilver, and rock-salt. In the country east of the great lake, the average northern limit of agriculture drops to about the 53rd parallel; but as the coast of the Pacific is approached, a milder climate is again entered, and the cultivation of the land can be pushed several degrees nearer to the Pole.

The railway marks in every respect a new chapter in the annals of a country which has so long been one of the great secrets of the world, and whose unexplored capabilities were almost unsuspected down to recent times. Till about 1580 we have the aboriginal period of Siberian history, when the country was only inhabited by a few nomadic shepherds in the south and the Lapp-like hunters and fishers of the

[1] This is being done at present by the strict rule about the felling of trees, whose indiscriminate destruction is altogether forbidden, but whose utilisation has become much more extensive than before. Every forest region is divided into forty parts; only one part may be felled at a time, and immediately old timber is cut down, new trees must be planted. A definite interval is fixed between the felling of one section and another; in a regular cycle of years the whole forty sections will be made use of and the wood-cutters return to the first.

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north. In this time there was, of course, no attempt to profit by the permanent riches of the soil, even in agriculture; flocks and herds were the only resources of the southern Tartars; in the catching of birds, beasts, and fish was the sole livelihood of the northern forest tribes.

From about 1580 the Russian conquest begins; it is completed (at least as far as Lake Baikal) by 1630; and with this an agricultural development of a certain kind begins. As time goes on, and especially during the eighteenth century, a commencement is also made in that mining development which has since become famous, and is certainly destined to a still wider celebrity. But till far into the nineteenth century these attacks upon the permanent riches of the land were of the most primitive kind, and though hunting and fisheries were carried on with some success, other resources quite as obvious, such as the timber-trade, were strangely neglected. Siberia, it has been often said, was till lately regarded by its rulers as nothing better than a refuse-heap, on which the criminal elements of European Russia might be conveniently thrown out; and, of course, there is much truth in this comparison. But what is forgotten by some of the critics is the fact that for the development of any country human beings are required, and you cannot open up immense regions of the earth's surface without a population adequate to deal with the area in question. Now the Russian dominions at the death of Peter the Great (1725), even then comprising more than five millions of square miles, only possessed some fourteen millions of inhabitants[1] to make use of all these lands, where, before the introduction of railways, steamers, and telegraphs, the problem of communication was much more serious than in Western Europe. Even at the commencement of the nineteenth century, the people of the empire did not number above thirty millions, and the attention of the Government and the people (throughout the eighteenth and earlier nineteenth century) was so concentrated upon European affairs that all things Asiatic were naturally and perhaps necessarily neglected. Daniel Defoe, in the second part of *Robinson Crusoe*, advises the Tsar to turn his conquests in the direction of the Celestial Empire, and assures him of an easy victory over the incompetent army and officials of China. Had this advice been followed, even in a moderate degree—as in 1858-60, or since 1894—it would inevitably have introduced a total change in the condition of Siberia. Apart from this, if the civilisation of European Russia had been more advanced, either the Government or enterprising individuals would have come to a better understanding of the value of Siberia for itself, and would have pushed forward the development of the country. But all this is to ask for something different from the actual facts of the case. The Russia even of Catherine II. and Alexander I. (1762-1825) was an extremely backward and sparsely populated country, whose very size was no small obstacle to its progress; whose climatic conditions were terribly hostile to civilisation; and whose peasantry (forming the great bulk of the people) were in a state of serfdom. Meantime the Government was continuously engaged in a series of European struggles, especially with Sweden, Poland, and Turkey—struggles by which the European State

[1] At present the empire has 130,000,000 people to its 8,660,000 square miles.

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was made a great power; by which the Baltic and Black Sea outlets were obtained; and by which the old Russian lands, so long subject to Poland, were recovered; but by which all things Asiatic were pushed out of sight.

It might have been expected, with the European settlement of 1815, that a better time would dawn for Siberia, and that it would share in the development of the European provinces; but it cannot be said that much improvement was perceptible in any way till 1858. Here, perhaps, (in the later years of Alexander I. and throughout the reign of Nicholas I.) the Russian Government may be most justly and severely blamed for its attitude towards the Asiatic possessions of the empire. The time had now certainly come, with the introduction of steam, the growth of a sufficient population, and the comparative quiet of European affairs, for Russian statesmen to have seriously faced the Siberian question. We can only say here that they neglected it down to the close of this second period—1580-1858.

This neglect, however, does not imply total want of attention. Four kinds of Russian and European emigrants had been slowly filtered into the country: first, the Cossacks, who were so active in the original conquest; secondly, the prisoners of war[1] and political offenders, who introduced something of culture and science in certain favoured districts; thirdly, exiled criminals, the class from which the Old Siberia was chiefly known; and fourthly, free (mostly peasant) emigrants, who now compose the great majority of the people. Even as early as 1590, however, "volunteer" emigration was called for by Government,[2] and at the beginning of the nineteenth century there were nearly half a million of these non-criminal settlers in Western Siberia alone, forming a good half of the people of Asiatic Russia as then constituted. But the life of these settlers was poor and sordid, and it was only in the seats of Government like Irkutsk that European civilisation could be recognised, so far at least as this civilisation was represented on the other side of the Ural range.

In 1858 the third period of Siberian history begins with the annexation of the Amur region and the maritime province, which first gave Siberia a good outlet upon the Pacific. The administration of Count Muraviev, who played the leading part in these annexations, was the first instance for many years of the application of real administrative ability to the distant Asiatic provinces. The same years were marked by the tardy introduction of steam upon the west Siberian rivers; and the emancipation of the serfs in 1861 put the question of emigration in a new light. Still, as yet, progress was very slow, and perhaps the chief event immediately affecting Siberia between 1860 and 1880 was the development of Vladivostok, which in 1872 was selected as the [illegible] Pacific port and naval station.[3]

[1] Such as the Decembrists of 1825. These men and their families made Irkutsk, for instance, equal to any city in the empire for intellectual attractions.

[2] The growth of the serf system after this time, of course, rendered volunteer emigration more difficult till 1861.

[3] This marked an advance in reference to which the development of intermediate [illegible] was now obviously necessary.

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From about 1880 things began to move somewhat more quickly; volunteer emigration largely increased by land, and commenced by sea. From 1883 the vessels of the Volunteer Fleet and other Black Sea companies began the regular conveyance of settlers from South Russia to the maritime province on the Pacific. In 1881, moreover, the Russian railway system was first pushed across the Ural mountains by the completion of the line between Perm and Ekaterinburg, soon after continued to Tiumen (1884), and forming a connection between the great river basins of the Kama and Volga on the one side, and the Tura, Irtish, and Ob on the other. This line, which we may really call the first Siberian railway, naturally suggested the question of further development, and in 1891 the fourth and present stage of the country's history was opened by the commencement of the new trunk line.

There had been much dispute on detail, and especially as to whether a line was to be attempted traversing the whole of North Asia, or only some smaller railways connecting the various chief river basins; and, again, whether the Northern Ural railway (from Perm to Tiumen) was to be taken as the basis and first section of the new line, or whether the eastern extension was to proceed from another point.[1] In the eighties, it may be remembered, the Volga was first crossed by the great railway bridge at Batraki, and the line from Moscow was pushed on through Samara to Orenburg in the south-east, and to Ufa in the north-east. After prolonged discussion it was the last which was taken as the beginning of the great scheme of 1891. At the other extremity, Vladivostok was the natural starting-point, and it was from the first arranged that work should begin from both ends. As a matter of fact, the formal commencement was made from the Pacific terminus, and the Heir-apparent (now Emperor) Nicholas cut the first sod at Vladivostok on May 19, 1891, in accordance with the Imperial order of March 17 of the same year, with which the enterprise began. The route selected was pretty direct between Ufa and Irkutsk, though in the original scheme it had to follow the windings of the Amur after leaving Lake Baikal. In a general way it may be described as following the 55th

[1] Among the earlier schemes for some sort of railway in Siberia we may notice the following, all subsequent to the impulse given by Muraviev'sa dvances on the Amur:—(1) In 1857-58 a project of one Colonel Romanov for a road and railway near the mouth of the Amur to avoid a part of the long northern bend of that river between Mariinsk and the sea. (2) 1857-58, the scheme of the English engineer Dull for a horse railway from Nijni Novgorod through Kazan and Perm to some port on the Pacific. This suggestion was not accompanied by any estimate of cost, and was of course not for a railway proper, but for a tramway. (3) 1857-58, the project of the American engineer Collins for a short line between the Baikal lake and the upper Amur. (4) 1858, the project of Morrison, Horn, and Sleigh, of a similar character to the tramway-scheme No. (2). Both (2) and (4) asked for such important privileges as to amount to a foreign monopoly of the whole trade of Siberia for a long period. (5) The proposal of Sophronov for a railway from Saratov to the Amur (1858-59). (6) The scheme of Kokorov and Rashet (1862), which was realised in the Perm-Tiumen railway. The same project was recommended by Colonel Bogdanovitch in 1868, and by the merchant Liubimov in 1869. (7) In 1880 the plan of the engineer Ostrovski, which as far as Irkutsk has been almost exactly followed. Canal development and the improvement of the rivers Ob, Yenisei, and Angara was the subject of a valuable series of reports and suggestions in 1880-81 from the engineer Sidensner.

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parallel of North Latitude as far as the Great Lake; beyond this the more recent Manchurian developments have bent its course a good deal to the south. As Ostrovski recommended in 1880, the railway traverses the agricultural or *black earth* region (the most fertile and best populated part of the southern zone of Siberia) in all its length, and thus becomes a natural backbone of the country. Reckoning from Samara on the Volga, it had seven sections assigned to its construction—(1) from the Volga to the eastern side of the Ural range, where its return to the plain country was marked by the important junction of Chelyabinsk; (2) from Chelyabinsk to the river Ob, passing through the official town of Omsk;[1] (3) from the Ob to Irkutsk and Lake Baikal, passing through or near Tomsk, Krasnoyarsk, and Kansk; (4) the short but very difficult line round the southern end of Lake Baikal; (5) the trans-Baikal line from the eastern side of the lake to the town of Stretensk, where the deep-water navigation of the Amur river begins; (6) the Amur valley line between Stretensk and Khabarovka at the junction of the Amur and Ussuri rivers; and (7) the Ussuri line, dropping south from Khabarovka to Vladivostok. Later on No. 6[2] was indefinitely postponed in favour of the direct line through Manchuria from the Upper Amur to Vladivostok, obtained from China in 1896, in return for the diplomatic aid given against Japan. To this last a new and important branch was added in 1898, running still farther south to the newly acquired harbours of Port Arthur and Ta-lien-wan on the Yellow sea. For the more rapid completion of the work the various sections were divided into three groups; and among these groups the first, which took precedence of all others, included the western and central parts of the line as far as the Baikal, and a short connecting branch between the northern Ural railway (Perm-Tiumen) at Ekaterinburg and the main trunk at Chelyabinsk. In the second group, the trans-Baikal line, between the lake and the upper Amur, and the extension of the Perm railway to Kotlas, were the chief items; and in the third came the Amur valley (or its substitute, the Manchurian) line. In the original plan it was expected to complete the sections of the first group by 1900, but matters proceeded so rapidly that by 1895 a careful estimate gave three years more for this part of the work, and it was, as a matter of fact, open for traffic by the autumn of 1898, when the first trains reached Irkutsk from Europe. The first and second sections between the Volga and the Ob were ready in October 1896; the seventh or far-eastern section, between Vladivostok and the Amur, was opened in September 1897; and the main trunk was joined to the north Ural line in 1896. The sections of the second group, the trans-Baikal portion, and the extension from Perm to Kotlas on the northern Dvina were finished before the end of 1899; and therefore, at the present time there only remains the circum-Baikal line and the Manchurian portion, about one-third of which was said to be ready at the time of the Chinese troubles of this summer.

By the June of 1900, 3375 miles of line had been laid down and were in use, without counting some 400 miles in Manchuria which were

[1] Now the capital of Western Siberia.

[2] The Amur Valley line.

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practically, if not formally, in the same state of advancement. This is the result of eight and three-quarters years' work, and shows a rapid rate of progress. Between Europe and Irkutsk, as well as between the Amur and Vladivostok, the train service has now become for Asia fairly regular and speedy—of course only a very moderate pace (less than twenty miles an hour) is attempted, but the primitive and haphazard progression which travellers found in the first months after construction cannot be spoken of now in the regions west of the Great Lake.

Steam communication has thus been completed between Europe and the Pacific; for the transit of Lake Baikal and the passage down the middle Amur is made in steamship as well, if not as quickly, as by the railway. Soon, indeed, the passage of Lake Baikal will be rendered unnecessary by the completion of the railway along the south-west and south shores of the Holy Sea, which (section No. 4) is expected to be ready for traffic within the next six or seven months.

The connections of the main trunk with the regions to north and south are of considerable interest. What is already made, under this head, is only a small part of what is designed, but it includes the important links between Chelyabinsk and Ekaterinburg, and the extension north-west to Kotlas on the Dvina, a large navigable river opening on to the northern ocean and thus affording an outlet for export trade by Archangel and the White Sea.[1]

Among the most important of the side-lines projected, but not yet constructed, is the branch from Chelyabinsk to the Lower Volga at or near Tsaritsin. This will connect with the recently completed lines from Tsaritsin to the Black and Azov seas, at Novo-Rossiisk, and at Rostov on the Don; with the still newer line just commenced from the same point (Tsaritsin) to Astrakhan; and with the Petrovsk-Baku line to the ice-free coast of the SW. Caspian; and it will thus afford an outlet for Siberian produce to the southern seas. Other branches which will probably be taken in hand within the next few years are the suggested lines from Tashkent to Omsk, uniting the Central Asiatic railway with the Siberian, and so bringing the influence of the Siberian railway in a sense up to the Afghan border; from Tiumen to Tobolsk; and from the neighbourhood of Tomsk to the mining districts of Barnaul and Biisk, already prepared for by the new and creditable steamer service along the rivers Tom and Ob.

From the first the Siberian Railway has been treated as a matter of national concern, and its administration has been put under a special organisation, called the Siberian Railway Committee, and still constituted as Alexander III., its founder, designed. Its first president was the Heir-apparent Nicholas, who retained this position on his accession to the throne. The members of the committee were partly *ex-officio*, comprising nearly all of the more important Ministers of State (*e.g.* Finance,

[1] This, however, being only a summer outlet, it is proposed to continue the Perm-Kotlas line either (1) to the Kanin peninsula, north of Mezen bay, where an ice-free strip has recently been found; or (2) to Ekaterina Harbour, at the mouth of the Gulf of Kola, in Russian Lapland.

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War, Marine, Communications, Agriculture, and Interior), and partly private individuals appointed for reasons of personal confidence by the Emperor himself (*e.g.* two generals and two State Secretaries). The committee was also to be assisted by the Economic Department of the Council of State, and by the occasional advice of the Siberian governors-general and of the other Ministers not holding a permanent place on the board (*e.g.* Foreign Affairs and Justice).

With this central management were also connected three preparatory committees, the first composed of representatives of the departments) *e.g.* mines, forests, rivers, etc.) interested in the undertaking. To manage the details of peasant colonisation which soon became so prominent, another sub-committee was appointed from the staff of the Ministry of the Interior; while a third, to deal with matters of practical railway working, was selected from the staff of the Ministry of Ways and Communications. This administration has not always succeeded in preventing local abuses, waste and peculation; it has encountered great difficulties, especially in 1896, through the unexpectedly great rush of emigrants, and its critics might accuse it of sacrificing in many places finish of detail to speed of construction; but its achievements have been great. It has provided an immense country with a new main artery, a new means of intercourse among a widely scattered people, and its work has already had a marked effect upon the population, mining enterprise, agriculture industries, and general prosperity of Siberia.

As to population, the railway age of Siberian development has seen beginning of the one of the greatest emigration movements ever known, and in consequence the Siberian people has doubled in numbers in the past ten years. By the commencement of the nineteenth century we have seen that one hundred and fifty years of possession had created a new Russia of European settlers, amounting to some 500,000 souls; as brighter days began to dawn, this new Russia increased more rapidly, and between 1860 and 1880, 110,000 free emigrants entered Siberia. Still rising, the tide flowed during the next twelve years (1880 to 1892) beyond all expectation, bringing 450,000 fresh settlers into the country by land, *plus* 17,000 by the maritime route from the Black Sea to the Pacific coast. Finally, after the construction of the Southern or Grand Trunk railway had been sufficiently advanced to aid in this movement, from 1893, it was no longer a tide, but a tidal wave of emigration. In the next seven years, 1893 to 1899, almost a million human beings moved from European Russia to new homes beyond the Ural—in 1893, 65,000; in 1894, 76,000; in 1895, 109,000; in 1896, 203,000; in 1897, 87,000; in 1898, 206,000; and in 1899, 225,000;—making in all 971,000 who went overland, besides 25,000 who were conveyed by sea to the Pacific coast. We must not forget that the first line over the Urals[1] was at work as early as 1881; and it is from this date that the emigration movement takes really large proportions. As early as 1885 this attracted the attention of the Government, and a special corps of land-surveyors and land-agents was formed to organise and regulate the settlement of

[1] Perm—Ekaterinburg—Tiumen.

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emigrants. In 1889 the present general law of Siberian Allotment was issued, by which every male emigrant going to the new country with the sanction of the Government has 15 dessyatines (or about 40 acres) assigned him "for perpetual use," and enjoys exemption from taxes for three years, reduced taxation for the next three, and postponement of army service for nine. Emigrants to the Amur and Pacific maritime territories have special privileges—100 dessyatines, or about 250 acres for each family, and exemption from taxes and conscription for twenty years.

On the formation of the Siberian Railway Committee, the general superintendence of the emigration movement, and of all matters connected with it, was intrusted to the new board, which, in spite of all temporary difficulties and failures, has planted upon the soil, with every appearance of permanence and success, the enormous body of new settlers who have entered the country in the last nine years. The committee has also done much useful work in spreading a knowledge of the local conditions among intending emigrants, and in accompanying the progress of the railway by provisions of every kind—loans of money, stores of timber, agricultural implements, medical necessaries, and other things specially called for by the settlers. It has also undertaken the building of churches and schools along the course of the railway: at the beginning of 1900, 165 of the former, and 105 of the latter were built or building.[1] It has built three orphan asylums for emigrants' children, and organised a travelling medical staff, and a corps of road surveyors, to carry out and maintain a permanent improvement in the Siberian "trakt." Besides the geological and mineral surveys undertaken by the Committee, a hydrographical survey has also rendered the river navigation of the Ob basin pretty well as secure as that of the Volga; work is now proceeding at Lake Baikal,[2] where four new lighthouses have been erected, and a great increase of steamer traffic is expected. Among other things, this survey claims to have shown that the Yenisei river has no bar, as sometimes alleged, and is navigable for ocean steamers for 1000 miles from its mouth; that the Ob is open from the sea to vessels drawing 12 feet of water; and that in the Gulf of Ob an excellent and sheltered harbour for large ships exists at the Nakhodka bay.

A special emigrant railway tariff has been settled, amounting only to twenty-five per cent. of the ordinary third-class fare; and thirty stations have been provided along the route (the chief of which is at Chelyabinsk) where the settlers can find medical aid, hospital accommodation, and places to stay until they are ready to go to their proper allotments. At these stations no charge is made for the attendance on, or food provided for, the sick; all children of emigrants, as well as the poorest class, also obtain provisions gratis at these places.

The better organisation of the emigration movement and the wider knowledge of the country (partly owing to the millions of descriptive

[1] With the aid of the Alexander III. Fund, which at the beginning of 1900 reached £120,000.

[2] Begun 1897, to be finished 1902.

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papers distributed by the committee among the peasantry) have reduced the number of haphazard or "independent" settlers, of the disappointed who return to Europe, and of the failures who perish on the way.[1] Most families who intend to go to Siberia now prepare themselves by sending on ahead a *khodok* or scout, who settles with the Government about the allotment of land, collects all necessary information, and pilots his friends and relations on their journey.

Mining enterprise has also been stimulated by the railway; alike in the Ural, the Altai, and the trans-Baïkal region decided progress has been made since 1881, and still more since 1891. This progress has been not a little owing to the new geological survey of Siberia, ordered by the railway committee with the view of "discovering useful minerals." Several important beds of coal have been found in the neighbourhood of the trunk-line and others at considerable distances from the same;[2] important deposits of iron ore were also brought to light in the trans-Baikal region; and discoveries were made of copper in the steppe country to the south of Omsk, and of jade in the province of Irkutsk. The gold-bearing districts of Siberia were also surveyed afresh, and previously unknown deposits were found in the valleys of the Yenisei, Lena, and Amur, on the shores of the sea of Okhotsk, and in the Kwangtung peninsula "leased" from China in 1898, on the very site of Port Arthur, and in the neighbourhood of Ta-lien-wan. There are few regions that surpass Northern Asia in mineral wealth, and it seems probable that in the near future Siberia will take a high rank in the output of other metals than the gold on which its past reputation is built.

In this respect, as in others, the progress of Siberia reflects that of European Russia, where, since the last Turkish war, industrial matters (and mining enterprise not least) have steadily advanced. The last annual report[3] of the Minister of Finance rightly lays emphasis upon this, which no one who has travelled intelligently in the country can overlook. New railways, new steamers, new manufactures, new mining works, new bridges, new electric trams, the deepening of rivers, the improvement of roads—these things are to be seen everywhere, and the Siberian railway in particular is the largest detail in an extension of iron ways which has averaged 2500 miles during the past seven years.[4] It marks the abandonment of the old policy of keeping the country in a state of nature, as a preservative against attack, for a new policy of binding together the most distant provinces by a network of communications.

As to agriculture, we have already referred to various measures recently taken for its encouragement in Siberia under the head of

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[1] 0·14 per annum now.

[2] Among the most important of these beds were those: (1) at Ekibaz-Tuza near Pavlodar; (2) at Sujenka; (3) at Mysovaya, on the eastern shore of Lake Baikal.

[3] January, 1900. This report gives the following statistics of mining progress:—
Russian total coal output: 1878, 1,774,000 tons: 1898, 12,000,000 tons.
Russian pig-iron output: 1878, 370,000 tons; 1898, 2,160,000 tons.
Russian steel output: 1878, 48,000 tons: 1898, 1,400,000 tons.

[4] In November 1892 the Russian railway net amounted to 18,670 miles; in January 1900 to 36,800 miles.

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population.[1] Here it may be added that between 1891 and 1899, nearly 20,000,000 acres (7½ million dessyatines) of Government land were allotted to emigrants in the provinces of Tobolsk and Tomsk, and 2¾ million acres (1 million dessyatines) of the pasture-country hitherto occupied by roving Kirghiz nomads were also devoted to Russian agriculture.[2] Large tracts, moreover, of the northern forest-zone or *taiga* have been turned to tillage. The irrigation of the dry steppe of Ishim has been commenced, as well as the draining of the marshy steppe of Baraba.

The improvements in the knowledge of Siberia and its conditions, and the increased use of better appliances in agriculture, together with the new communications, have opened quite a fresh chapter in the treatment of the Siberian soil, and brought about the commencement of an export trade in grain. Here the northern railway with its outlet to the Dvina and the White Sea has been found especially useful.

The development and effect of the Siberian railway must also be taken in connection with the river navigation of Siberia, and of the eastern parts of European Russia. Everywhere in the empire the connection of railway and steamer traffic is one of the chief elements in the system of ways and communications; and as elsewhere, so in Siberia. Immediately the iron horse enters the country, the steamer appears or multiplies upon the rivers. Thus in the whole Ob basin, as late as 1880, there were only[3] 37 boats of this kind, but in 1898 the number had risen to 120. Among these are some of the best Volga or Mississippi pattern, with every necessary, and even luxury, of travel.[4] On the Yenisei basin progress has been slower; the difficulties of navigation on the Lower Angara, the *branche maîtresse* of this basin, have been an excuse for past backwardness; but the steam traffic on the Yenisei itself is undoubtedly capable of great improvement. On the Lena a beginning has been made, but here, in a mainly Arctic basin, with a mouth practically sealed against the outer world, traffic is limited to the upper river, and to a short period of the year, and will probably wait for the assistance of a branch connection with the main trunk[5] before any marked advance is made. But on the Amur, which so naturally forms a part of any line of communication across Northern Asia, steamers have rapidly increased, even though the main stream was not tapped by any railway till the autumn of 1897. At that time the twelve paddlers of 1870 had increased to ninety-four.

[1] It is only wonderful that so rich a soil should have had to wait so long for the beginnings of proper cultivation.

[2] Out of a surplus of 25 million acres (10 million dessyatines) not required by these Kirghiz.

[3] Ten in 1860, twenty-two in 1870. For purposes of comparison we may mention that the Volga basin has about 1300.

[4] As in the new service between Tomsk, Barnaul, and Biisk on the rivers Tom and Ob, opened this summer (1900). The five chief steamer services on the Ob basin (1) Tomsk—Tiumen; (2) Omsk—Tiumen; (3) Omsk—Semipalatinsk; (4) Tomsk—Barnaul—Biisk; (5) Tomsk—Chulym are all connected with the chief districts of Siberian cultivation and population, and have a great advantage over the sparsely peopled Yenisei basin.

[5] *e.g.* by a line from Irkutsk or Kansk to Kirensk.

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Two of the earliest sub-sections of the Main Trunk in date of completion were those between Achinsk and Krasnoyarsk, connecting the basins of the Ob and Yenisei,[1] and between Omsk and Kolyvan, connecting the Ob with the upper course of its chief branch the Irtish. Especial energy was also thrown into the work on the later section between the Baikal and Stretensk on the Upper Amur, connecting the basin of that river, not only with the Great Lake, but also with the Yenisei-Angara; and this portion of the line was beset with so many obstacles and dangers from floods and landslips, that its opening at the end of 1899 was a surprise to most of those who had watched the slower execution of less troublesome details. In all these instances the connection of iron road and waterway is the immediate object; and one result is seen in the development of the river traffic. Thus on the central part of the Ob basin this is reckoned as 50,000 tons (3 million pûds) in 1886; at 266,000 tons (16 million pûds) in 1895.[2]

No part of the Siberian railway is more noticeable than the system of bridges by which it is carried over the great streams of North Asia. These bridges, west of Lake Baikal, cover a space of thirty miles; the longest[3] are those over the Irtish (2100 feet), over the Ob (2500 feet), and over the Yenisei (almost 3000 feet). With their spans of from 300 to 500 feet (the Yenisei spans measure 490) and their massive piers and iron-work, they present an extraordinary contrast, like most of the new industrial Muscovy, to the thatched roofs and primitive dwellings of so many of the villagers, representing what was till lately the only type of country Russia.

Lastly, the immediate results of the Siberian railway may be illustrated from the statistics of passengers and goods carried during 1896, 1897, 1898, and 1899. The figures for passengers are, respectively, 417,000, 600,000, 1,049,000, 1,075,000; for goods, in thousands of tons, 184, 443, 700, 657.

Among exports from Siberia, the chief is grain (42 per cent.), then come meat, butter, tallow, hides, wool, eggs, and game. Of goods in transit tea is still the principal, and the amount carried by the line in 1898 was 36,000 tons, as against 28,000 tons in 1897. Among imports, the chief are raw iron and machinery.

When the whole railway is completed it is intended to increase the speed of passenger trains to twenty-three miles an hour and of goods trains to fourteen miles an hour. This is the rate adopted on the American inter-oceanic lines, and, slow as it may seem, it will then be possible to go from Moscow to Vladivostok[4] or Port Arthur in ten to

[1] Also now connected by a small and shallow canal, which needs deepening to be of any great use.

[2] As to the connections of the Siberian line with the river system of European Russia, it is enough to repeat that the Volga is crossed by the main trunk at Batraki, is touched by the same at the river-ports of Syzran and Samara, and is connected with it also through the Northern Ural railway which crosses the Kama at Perm. From the Volga river steam communication is now possible to almost every part of the European territories of the empire.

[3] Not counting that over the Volga at Batraki, 4300 feet.

[4] First class. The present time from Moscow to Vladivostok is about seventeen days.

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eleven days, at a cost of £12. But from London or Paris to Shanghai by the present sea route takes thirty-five days and costs, in first-class fare, over £80. The Siberian railway thus offers a possibility of a new way to East Asia, which, when allowance is made for excessive hopes and over-great expectations on the part of its promoters, will probably be speedier, shorter, and cheaper than the maritime circuit round Arabia, India, and the Malay peninsula. On the other hand, a very long railway journey must always be more fatiguing than a sea voyage, though where men are travelling for business alone, time and money may outweigh all other considerations. On ordinary Russian trains fatigue is greatly reduced by the excellent sleeping arrangements; and in the Siberian *train de luxe* the ease and rest of sea or river travelling is perhaps approached as nearly as is possible on iron roads.

In any case, the new trunk line connects Europe and the thickly peopled world of China and Japan (three hundred millions on one side, four hundred millions on the other) by a fresh highway whose advantages are obvious. It connects Russia with the Pacific coast in a way unknown before, and it will probably lead to the development of an ocean service between this eastern outlet of eastern Europe and the Western States of the American Republic. From the strategic point of view it would seem to give Russia the command of Manchuria, now being traversed by railways that start from Moscow; it also appears to give the same power a very strong hold over Northern China, south of Manchuria. If Mongolia is crossed by the projected straight line from Kiakhta to Pekin, *viâ* Urga and Kalgan, what has just been said of Manchuria may be also said of this vast but thinly peopled region.

From a general point of view the Siberian railway, even more than the Central Asiatic, marks the growing importance of overland routes. The maritime ways have for so long commanded attention as the chief means of communication between far distant regions—it has so long been true that the sea "unites rather than separates"—that the future, opened by the new Continental lines in Siberia and Turkistan, is even now difficult to appreciate.

The railway across Northern Asia, from an internal point of view, acts as a distributor of a population at present exceedingly uneven; it takes away from congested districts, like the SW. of European Russia, and fills up great wastes beyond the Urals; it is now the chief factor in one of the largest racial movements in the world. Here, in the union of these two forces, modern communications and a movement of racial emigration,[1] lies the special importance of the Siberian railway. As this racial movement touches (and will touch more and more) districts where only Asiatic civilisation and means of defence are to be found, it seems not improbable that it will continuously advance and absorb until it reaches the thick mass of unmalleable material in China proper. Russia has already reserved to herself, by agreement with Great Britain, the

[1] Based upon a yearly increase of nearly 2,000,000 in the population of the empire as a whole; 1½ millions of this annual surplus of births over deaths belong to European Russia.

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exclusive right to build railways north of the Chinese wall, and the control of Asia north of that wall seems to be in her hands when she has completed the lines already in construction or authorisation.[1]

But apart from these political matters, it is only fair to recognise (which has been one of the chief objects of this paper) that the Siberian railway is the principal agent in a work of civilising and reclaiming a huge but long-neglected country of no small capabilities; that it goes along with many other measures for the same object, such as the foundation of the University at Tomsk and the abolition of the exile system; and that it cannot be dismissed as nothing more than an aid to expansive territorial ambitions. It is but the greatest item in a remarkable system of communications by land, river, and lake which Russia has been recently developing, and it deserves a fair appreciation at the hands of all those who are interested in the present condition and immediate future of Europe and Asia.

THE VALLEY OF THE JOUX (JURA).

By VICTOR DINGELSTEDT.

THE author has spent many a summer in the happy valley of the Joux, greatly benefited by his sojourn both physically and morally; and on this account feels himself sufficiently justified in presenting to the readers of this magazine a rather long description of the country and its inhabitants. He has been assisted in this task by several friends who live in the country summer and winter, and he here wishes to express his acknowledgment to Messrs. Gauthier and Samuel Aubert, professors in the College of Sentier, Dr. Yersin, the doctor of the valley, and Alfred Reymond, an amateur naturalist.

The Jura.—Before entering into our proper subject, a few words concerning the Jura may be acceptable.

Rising between the Rhine and the Rhone, the Jura Mountains represent a typical instance of remarkably regular wrinkles in the crust of the earth. With the exception of two comparatively small tracts—one to the north-east, and the other to the south-west—which have escaped compression, and consist of approximately horizontal strata (Tabular Jura), these mountains form a series of parallel or almost parallel ridges (mostly anticlinal), separated by intervening valleys (mostly synclinal). According to Sir John Lubbock (*The Scenery of Switzerland*), some one hundred and sixty undulations and about fifteen main folds, nearly

[1] The railway development of Siberia is to be completed by the construction of a large number of branch or side lines from the main trunk to all the chief centres of Siberian life at a distance from the present railway.

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parallel to one another, constitute the Jura. These folds are most numerous and at the same time less pronounced to the south-west, gradually rising towards the north-east, and terminating with a single anticlinal, which crosses the Reuss south of Brugg and vanishes at Regensberg. In all cases, the amount of compression seems approximately equal along the whole line, the folds increasing in intensity as they diminish in number. The range is about 156 miles long and 38 broad, rising to an average height of from 3950 to 4600 feet. The ridges are crossed by numerous transverse valleys or cluses, formed, perhaps, by the vibration of the earth which caused the elevation of the Alps, and now constituting a natural exit for its streams. In the whole, there are about a hundred more or less high and oblong ridges detached in this way, forming between themselves a corresponding number of longitudinal and cross valleys—seats of industry and agricultural activity. The most important among the cross valleys or cluses are those from Pery to Biel, from Moutier to Delemont, Val-Travers, and Vallorbe-Pontarlier. The strata entering into the composition of the Jura are mostly Cretaceous and Jurassic or Oolitic (Lias, Dogger, and Malm). Underneath these strata appear here and there rocks of Triassic and Carboniferous age; while overlying them in certain places occur deposits of Eocene age. Glacial accumulations are frequently in evidence at the surface. The dominant rocks throughout the region are limestones and calcareous grits, etc.

The principal summits of the Jura are: Mont-Tendre, 5512 feet; Creux de la Neige, 5633 feet; and Gr. Credo, 5276 feet. Commanding the routes from France to Germany, Switzerland and Italy, they are of great historical importance. Compared with the Alps, the mountains are as beautiful without being awe-inspiring, while their inhabitants are less given to superstition than the denizens of the Alpine valleys, and are mostly Protestants.

The Valley of the Jura is one of the longest longitudinal valleys, and may be considered as typical of the Higher Jura. It extends between 46 33′-46 41′ north latitude and 3 47′-4 east longitude, on the west-south-west corner of Switzerland. It is situated in the southern division of the Jura, which is the most confused and complicated, and formed by two synclinal parallel Neocomian hollows, separated by a small anticlinal abrupt ridge which borders the lake of the Joux on the north-east, and continues in a straight line up to Fort des Rousses. In the largest of these synclinal folds or hollows, which contains the lake, have been observed some outcrops of Rhodanian (*Calcaire à Requienia ammonia*, on the horizon of the Atherfield clay in England and Normandy) and Gault, whilst everywhere else the valley is covered by boulder clay and alluvium. In the most narrow of the depressions, near the lake of Ter, have been discovered the outcrops of fresh-water limestone of Eocene age. The length of the double valley is about ten miles, beginning on its south-west side a little above the lake of the Rousses, whence open the passages of Moraz, St. Cergues, and Col de la Faucilles, leading to other valleys, and continuing in a north-east direction; one of the two synclinals vanishes at the foot of the precipitous Dent-de-Vaulion,

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while the other continues in the same direction towards Vallorbe. Our valley is thus encircled by five ranges—that of Risoux on its western side, 30 kils. long and 1423 m. high; Dent-de-Vaulion on the east, Mont Jeudre more to the south, its south-east prolongation being the Noirmont, 1550 m., and the rocky Dôle. All these ranges and valleys are composed of the flexures of the upper Jurassic strata, ranging from Argovian, through Sequanian, up to Portlandian.

The Area.—In these limits, the country has an area of about 6171 square kil., more than half of which, or 58 per cent., are high pastures, a quarter forests, about 11 per cent. grass-fields and low pastures, 4 per cent. meadows, and the remainder streets, edifices, gardens, and orchards. The area of the Joux valley is 163·4 square kil.

The Soil owes its origin chiefly to weathering and the action of vegetation, and only in the second degree to transport and deposition by wind and water. The rocks have been considerably disintegrated by the carbonic acid contained in the rain, and under the influence of this carbonated water percolating through the limestones some remarkable crevasses and caverns have been formed. A good instance of this is the "Grotte aux Fees" above the sources of the Orbe. Limestones as rocks of dense structure, very permeable through their fissures, are not hygroscopic, and favour the growth of a particular vegetation, distinct altogether from that which prefers the absorptive rocks. Here and there occur tracts more or less thickly covered by glacial clay, which renders them marshy.

The Drainage.—There are two particulars concerning the hydrography of the country. Its soil being highly permeable, its rivers do not exercise any appreciable geological action, and, in consequence of a considerable part of the rain escaping by subterranean passages, there is not habitual correlation between the amount of rainfall and the river discharge. Several of the streams do not run on the surface, but underground. The Jura is considered poor in rivers and streams. The rain and melting snow escape through numerous fissures of the limestone, and reappear in copious streams when collocated at the surface of some impervious and mostly marly stratum. The springs, following the inclination of the strata, are copious and numerous on the eastern side of the Joux valley, where the strata that enter into the formation of the Noirmont and the Mont Tendre are inclined towards the valley, but scarce on the western side, where the beds dip to the west.

The main stream in the region is the Orbe, rising from some subterranean cavern of the Mont d'Orsaire and the lake of the Rousses, at an altitude of 3309 feet, and after a lazy course in a north-east direction, loses itself in the lake of Joux. This lake has no effluents, and its waters escape by swallow-holes or funnels called "entonoirs." Seven of them are on the western shore of the lake, four upon the left bank of the lake Brenet and one upon the right bank. The most important of these holes is the Bon-port, on the shore of the Brenet, which consists of a transversal fissure in calcareous rock. As mentioned by Professor G. Egli (*S.G.M.*, vol. x. p. 596), it has been proved by means of fluorescein poured into the escaping waters at Bon-port, that after a

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long subterranean passage, these waters flow out of a wall of rock a little above the village of Vallorbe. This abundant stream has always been called "la source de l'Orbe"; its mean annual discharge is estimated at about 5 cub. m. (4·86) per sec.; it constitutes the origin of the lower Orbe, which traverses the main chain of the Jura, forms the falls of the Dey, joins the Talent near Ependes, and, under the name of the Thiele, empties itself in the lake of Neuchatel.

We are here concerned only with the upper Orbe (anc. Quinzonnet). On issuing from the Rousses it winds into the valley of Boie d'Amont, traversing a slight elevation of the ground on the Franco-Swiss frontier; thereafter meandering in a feebly inclined bed among meadows, peat-bogs and morasses, bifurcating and reuniting at intervals; until, approaching the lake of Joux, the meandering becomes accentuated and the current scarcely perceptible. After heavy rain, the river overflows its low banks, and amidst the reed-grass and sands obstructing the passage, enters, as it were, a lake into the lake. Like the Doubs, Reuse, and Valserine, it is a longitudinal consequent river of a very quiet temper, its mean slope being only 0·0033, falling as it does 216 feet in a course of 12½ miles (4½ m. in France and 8 in Switzerland). Its length is increased one-fourth by its windings; while its catchment basin is equal to 125 sq. kil. Its clear waters constitute a mirror which reflects the peaceful character of the country. Flowing calmly and quietly, it perseveres in its useful work, draining the land and working numerous sawmills, silently overflowing its banks and as silently withdrawing within them. Almost hidden by shrubs and grasses, it bears upon its usually smooth surface slender and graceful stems of the water-lily (*Nuphar lutea*) and other plants. Its waters are very pure and cold. It has no affluents on its left bank owing to the strata dipping westwards, with the exception of several small streams here and there after snow melting. On its right bank, however, it receives about twenty brooks and streams. These are mostly dry in the hot summer, except Biblanc (Biefblanc) in the Burtignere mountains and the Brassus issuing from an abundant source—Pré-de-bière—at the foot of the Marchairu, east of the important village of the same name. It is scarcely 1000 yards long, but its excellent water is conducted as far as Sentier and Rocheray, furnishing a considerable motive power for several manufactories and sawmills.

The mean annual discharge of the Orbe is estimated at 2·88 cub. m. per sec., or 0·09 cub. k. per annum (98·4 millions *tonnage*), but the number varies from 0·5 cub. m. per sec. as minimum and 72 cub. m. as maximum.

Besides these there are only two other streams worth mentioning. They are the Lionne, rising from a source called Chaudiere d'Enfer in the rock at the foot of M. Tendre, near Abbaye; and the Saigne-Vuagnard, from a source at the foot of the Dent de Vaulion. The mean annual discharge of both these small streams does not exceed 0·3 cub. m. per sec., but they are very useful as motive powers.

Lakes.—Besides the Rousses, which is in France, there are three lakes in the region under consideration—the Ter, Brenet, and Joux.

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The Brenet is connected with the Joux, and was formerly a flat traversed by a rivulet (Bre-naid), which conducted the waters of the lake to the foot of the Epine mountain, and growing at length into a fish-pond, gradually expanded into a lake. It furnishes an excellent ice, no habitations being near to contaminate its waters. It has an area of 0·22 sq. m. (2 km. long, 415 m. broad, and from 10 to 15 m. deep). The Ter is a small, almost circular, lake between Sechey and Lieux, with an altitude of 3363·4 ft., and situated in the same synclinal fold as the Brenet. It is about 300 m. long, 200 m. broad, and 15 m. deep, abounds in fish, and is remarkable, as we shall presently see, from a botanical and entomological point of view. The lake of the Joux (signifying "forest"), with an altitude of 3311 ft., has an area of about 3·92 sq. m.; it is 5·24 miles long, 1058 yards broad, and up to 100 or perhaps 112 f. deep (*S.G.M.*, vol. ix. p. 481). The volume of its waters, combined with those of the Brenet, has been estimated at 2764 million cub. ft., or 77 million tons. Its north-western side is abrupt and rocky and runs in a straight line without any creek or recess, whereas the opposite shore rises gently, is undulating and low, forming several bays, capes, and promontories. This side of the lake, however, is subject to inundations in thaw-time, and the villages are in consequence constructed at an elevation some distance from it.

The area of the lake is gradually decreasing in consequence of sedimentation, of desiccation, and probably also of waterplants moderating the current and favouring the formation of vegetable soil. As already said, the lake empties by the funnels, this discharge naturally varying according to the level of the lake. With the level at 1006·2 metres, it reaches 1·60 cub. m. per sec.; it is double that volume at a level of 1008 m., and threefold when the level rises one metre more. The mean annual discharge of the "source" of the Orbe, collecting probably all the waters of the lake escaping by all funnels, is estimated at 4·86 cub. m. per sec., which is superior to the mean annual discharge of the funnels (3·14 cub. m. per sec.), the surplus coming from the waters on the right or eastern side of the valley.

In winter the streams and lakes are frozen. The lake of Joux begins to solidify at the end of December, at the rate of about an inch a day when the weather is sufficiently cold, and is soon transformed into an icefield, strong enough for skating or even for the passage of vehicles, up to the end of April, when the thaw begins. The sheet of ice formed on the lake is 13·20 and even (as it was in the winter 1871-72) 39 inches thick. There always remain, however, a few ice-free patches, due, according to the interpretation of Prof. F. A. Forell, to the presence of teals and mallards. The temperature of the lake varies according to seasons from 32·7 to 67·6°, while that of the springs remains fairly constant from 44·5 to 48° F.

Climate.—The principal elements determining the climate are the temperature of the air, its pressure, the rainfall, and nebulosity. As compared with the Alps, the air of Jura at a corresponding altitude may be generally pronounced as colder and as less dry and constant. It is certainly tonic, invigorating, brisk, and stimulating, yet not agreeing with

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over-delicate persons, with the exception of consumptives, who benefit greatly. The difference between the two extremes of temperature is considerable, the heat attaining 80° F. and the cold —40° F. And yet it is the cold season that is perhaps the most agreeable and certainly the most healthy. The winter is mostly dry and sunny; the snow, generally abundant, cleans the air, and covers fields and forests from the beginning of December to the end of March. While the plain to the north of Geneva Lake is lost in fog, rising up to 2500 and 2900 feet, here in the valley all is splendour and sunshine. The nights are cold, but as soon as the sun appears on the horizon the air is softened and the temperature, even in January, rises to 37 and even 41° F. The effect of the sun increases with altitude. Thus, on sunny days, the thermometer in Sentier and Chez-le-Maitre registers a minimum of 10·5° and even lower, while that in Risoux, 1280 f. higher, indicates at the same time a minimum of 28·426, and 23° only. At the time of such inversions of temperature, the woods upon the high ridges are enlivened by the songs of warblers and linnets, and one may occasionally pluck gentians and daisies. This season is remarkably healthy, few cases of sickness occurring. The extreme cold attains —26° and exceptionally —40° F., and is attained by the north-east wind (*la bise*) which lowers the temperature. The mean winter temperature is 21·5° F.

The spring is less healthy and less agreeable. The thawing snows chill the air and the return of warmth is checked by the "rebuse," hail, shower, and sleet. Not that the season is without its charms as the slopes and the valley gradually recover their usual dress of fresh verdure and showy flowers, and the ear is gladdened after the winter stillness by the music of numerous brooks. This is the time of the greatest variety in temperature, the thermometer occasionally descending as low as 12° and even 5° F., and rising to 62° in April, 65·5° in May, and 73° in June. The mean temperature of the season is 37° F. The summer is sometimes warm and fine, sometimes rainy and cold, sometimes stormy and greatly variable. The hottest days in July and August attain a temperature of 79·7 and 80·6° F. respectively; but they are invariably followed by cool nights. Thanks to the abundant dew, the grass remains always green, and the aspect of the valley, with its fine carpet of meadows strewn with innumerable flowers and with its wall of dark, still woods, is charming,—a true oasis of peace and happiness. The mean summer temperature is 53·2° F.

The autumn is sometimes rainy but mostly dry, warm, and fine. The air is brisk and fresh in the morning, but towards midday the sun becomes warm and the temperature genial, although there is a great difference between the sunny and the shady sides of the valley. The nights are frosty, and one cannot do without a fire. In October the thermometer descends to 41·2° F.—the mean annual temperature being 38·2° F. It is therefore only in the summer and autumn that the mean seasonal temperature is above the mean annual, whilst in winter and spring it is below it.

We give in the table the most important data regarding the monthly temperature:—

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	Mean Monthly Temperature and Rainfall.			Height of Barometer.	
	Sentier. Per cent., F.	Sentier. Ins.	Risoux Capt. Ins.	Vers-chez-le-Maitre. Mms.	Ins.
January,	21·2	2·64	3·93	678·9	26·48
February,	21·5	2·40	4·64	675·9	26·36
March,	28·7	4·75	9·36	674·1	26·29
April,	35·3	4·18	7·33	671·5	26·19
May,	46·4	5·90	8·27	674·2	26·30
June,	52·7	5·75	7·02	677·6	26·42
July,	55·0	5·64	8·73	676·9	26.39
August,	55·5	6·53	8·68	678·1	26·44
September,	49·8	3·62	5·15	679·1	26·49
October,	40·1	6·25	8·81	675·7	26·35
November,	35·3	5·38	6·47	676·7	26·38
December,	23·4	4·85	6·24	676·7	26·38
Annual,	38·8	57·89	84·63	676·3	26·38

Rainfall.—From the region of the lake of Geneva north-westwards towards Jura, the rainfall steadily increases with altitude from 35·37 inches annually on the lake of Geneva, up to 57 inches on the lake of Joux, and continues to increase with altitude in the mountain chains surrounding this lake. While the mean annual rainfall in Sentier is about 58 inches, it is 77 and 84 respectively in the Post des Mines and Châlet Capt situated on the crest of Risoux, some 1600 feet higher. But there are considerable variations in the amount of rain recorded from year to year at the same place, and from month to month in different years. This amount may vary in the first case from 1 to 1·5 ins., and in the second from 1 to 20 ins. On the average there are about 165 rainy days in the year (from 157 to 187). The most rainy-months are March, May, July, August, and October; the least rainy are January, February, and September. Maximal precipitations recorded are from 50 to 150 mm. at once. We may take the mean for the greater part of the country as equal to 65 inches, and for the region of Risoux about 79·25 inches. The rain is distributed according to the seasons, thus: 17 per cent. of the whole falls in winter, 27 per cent. in spring, 29·8 per cent. in summer, and the rest, 26 per cent., in autumn. We give the mean monthly in a table. It is clear that a considerable part of these precipitations falls in the form of snow. It may snow, indeed, in every month of the year, although in the summer months this, of course, occurs very rarely—February, March, April, and December being the real snow months. The mean annual depth of snowfall is about 18½ feet on the Risoux, and a little more than half, viz. 9·3 feet, in the valley proper. The mean number of snow days is 68 in the mountains and 50 in the valley, the heaviest fall on record being from 14 to 17·5 inches at once.

Ratio of Drainage to Rainfall.—The average rainfall of 73 inches upon an area of 163 square kilometres gives annually about 0·306 cubic kilometres, or 0·07956 cubic miles of water. The mean average discharge of the Orbe being 0·09 cubic kilometres, it follows that about one-third of the total rainfall is run off by streams and subterranean funnels, whilst the rest is partly evaporated and partly absorbed by the soil.

Wind.—Two principal winds predominate: "la bise," or north wind,

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which blows from NW., N., and NE., and is generally dry and cold; and "le vent," which blows from SW., S., and SE., and is generally damp and warm. There are, in the mean, about 123 days in the year with the former, and 196 with the latter, 46 days remaining comparatively calm. The strength of the wind is, of course, very unequal, the strongest being in winter, with the predominating north wind; but the most terrible hurricanes come from the SW., and it is this side of the houses that is specially protected by "bardeaux" or "ancelles" (tiles of wood). These southern winds predominate in May, August, and December. For 100 observations, there are 61 winds from the north in January and February, and 75 from the south in May and August. Besides the predominating "la bise" and "le vent," there blow occasionally some local winds, such as NW. ("Joran"), bringing cold and snow, and WSW. ("Moussillon"), bringing storm and shower, and so on.

The country is subject at very rare intervals to cyclones or tornadoes, and the writer was witness of one of the most recent of them which occurred on 19th August 1890. It was towards the evening of a very hot day that the whirlwind, accompanied by severe thunder and lightning, coming from all parts of the horizon, and travelling at a velocity of 80 miles an hour, broke out at St. Claude, at 7·37, and in less than an hour, following a sinuous line, arrived at the railway station of Crot on the Pontarlier-Lausanne line. The direction of the hurricane was from SW. to NE., but when half-way it flinched from the southern to the northern slope of the valley, and with a breadth of about 1090 yards. The gyratory movement was easily recognisable by the position of the felled trees, fragments of wood, and different kinds of wreck, which marked out upon the ground curves of about 500 yards in diameter. The tornado was accompanied by a considerable discharge of electricity, the appearance of cone-shaped clouds, and the formation of lateral and vertical currents.

The disastrous phenomena were preceded for about the space of half an hour by almost uninterrupted lightning—the dark and heavy sky was enflamed; every moment the lightning flashed from cloud to cloud, and from the clouds to the earth, and the thunder which followed was not of the rolling description, but sharp, instantaneous reports. Beasts and men were terrified, but instinct hurried everybody to seek protection. Although, fortunately, there were only a few victims, it is not easy to give an adequate description of the ravages wrought, a considerable number of large houses having been pulled down, many unroofed, and their chimneys, board-shingles, furniture and the rest, scattered in all directions. A large part of a pine-forest had been overthrown, thousands of trees cut off at their base; thousands more, twisted and distorted, lay with their roots bare. Houses had been struck by lightning and burned down. An enormous quantity of different kinds of wood-work, beams, trunks, stems, branches, tiles, nails, ironsheets, and so on, violently projected, had sunk deep into the ground or were widely dispersed over the surface.

A number of curious effects were observed. In a cottage at Carroz, for example, four persons seated at table in the midst of a room were

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all simultaneously transported towards the door. Milestones of 160 lbs. had been pulled away, and stones weighing 267 lbs., and almost hidden in the ground, had been wrenched out. The top of a pine had been cut off, and projected to a distance of 625 feet. In the beautiful forest of the Bois-a-Ban, above Abbaye, where the tornado had cut out a passage 800 yards wide and above 1000 yards long, 120,000 large pine-trees had been either broken at the base or pulled away with their roots bare. At its eastern end, when it had become exhausted, the tornado terminated with a heavy fall of hail which, on the north of the lake of Neuchatel, extended from the Valeyres-sous-Rances on the west, up to St. Aubin and Gorgier on the east. A number of persons were more or less severely wounded, although there were no fatalities in Switzerland.

Pressure of the Atmosphere.—The mean height of the barometer in the valley is 26·38 in. (it is 28·35 in. in Geneva). The mean monthly oscillations are from 0·26 to 0·34 in.; the maxima being, in September and August, 26·48 in.; and the minima, in April, March, and May, 26·19 in. There is no very accentuated rise in any season, though a fall generally occurs from January to February. The difference between the highest mean monthly and the lowest is 0·53 in.; while that between the mean annual from year to year may be about 1 mm. The absolute oscillations in a year may attain 30·5 mm. or 1·2 in.

Sunshine and Nebulosity.—Expressing with 10, a sky completely overcast, and with 0, a clear sky, the number 5·73 will express the mean annual nebulosity; the brightest, September and December, stand at 3·29, followed by August and July at 3·85. There are in the average 95-100 days in the year with a sky having a nebulosity under 3, and 137 days having a nebulosity above 8. As to the insolation, we may reckon on an average of 30 per cent. of sunny days in the year, 28 per cent. fairly bright, and 42 per cent. overcast. According to observations in Pont during the last three years, there are on an average 231 fine days, 48 doubtful, 84 rainy, and 2 foggy. Fog, however, comes very seldom, though there is usually a difference in temperature at different hours of the day. The dew and the hoar frost are very copious and frequent, especially in late summer and autumn.

Storms.—The number of storms is very unequal from year to year. Some years are very stormy, others are very quiet, but the mean average of storms is about twenty-five yearly. They break generally in the afternoon about four or five o'clock—there are five times as many at this hour as in the earlier part of the day—and frequent the surrounding mountains more than the valley proper. They impart a sensation of awe, and alter the weather generally for some two or three days.

Phenology.—At the beginning of March the first larks arrive, and by the end of the month the meadows are green. During the first half of April the swallows arrive, and at the same time, and occasionally later, the ice of the lake begins to break up. The end of May hears the first cry of the cuckoo, and on the 1st of June the cattle are sent up to the mountains for pasture, to descend again after the 1st of October. June also is the blooming time of the sorb, pine, lilac, horse-chestnuts,

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apple-trees, etc., although the late frost occasionally kills the buds and flowers. In the middle of July the dandelion throws its seeds, and hay-making—which lasts four weeks—begins. Further on in the month the strawberry is ripe, and in the forest can be gathered delicious agaric. At the beginning of August the dandelion flourishes for the second time; a little later the children are gathering the raspberry and blackberry in the forest, and upon the mowing of the meadows, the crocus, which is the first autumn flower, appears. At the end of August the second hay-making begins; in the middle of September the small harvest of rye and oats is usually unripe, and is generally left standing till the middle of October. Towards the end of September the landscape becomes invested with the colours of autumn, the swallows depart, the window-glass becomes ornamented with ice-flowers; October drives in the first snow, and two months later, the true winter, with frozen lakes and rivers, with sledging and skating, sets in.

Vegetation.—The country has an eminently green aspect when it is not covered with snow. In fact, the Jura presents very favourable conditions for a rich and varied vegetation. We cannot, of course, enter too greatly into details concerning the subject, already treated with considerable completeness by such authorities as MM. Babey, J. Thurmann, Ch. Godet, and others. According to J. Thurmann (*Flore de Jura*), there are to be found representatives of 136 natural orders or families—112 exogenous and 24 endogenous. There is certainly a great distinction to be made between scattered and abundant species, and those which are rare and exceptional. The largest number of species occur in the orders of Compositæ, Leguminosæ, and Gramineæ, followed by Cruciferæ, Cyperaceæ, and Caryophylleæ, each numbering over a hundred species. The valley of the Joux, considered alone, presents many interesting botanical features. At the side of the native species there are others having their origin in Central Europe, in the high Alps, and in Arctic and Asiatic regions. This, no doubt, is the result of the great diversity of situation, several growing on the sides of rocks exposed to the full heat of the sun, others protected against the cold wind and enjoying a light permeable soil, and others again in the midst of damp and cold peat-bogs and morasses which suggest the Arctic regions. Accordingly the flora may be divided into five zones or associations.

(1) *Meadows and Cultivated Lands.*—These, which occupy the floor of the valley and ascend the flanks of the mountains to a height of 3600 feet, possess a soil, and therefore a vegetation, of the richest description. Here, where the competition between the different species and the genera is fiercest, the greatest variety of plants is found. It is a vegetation generally adapted to a medium condition of moisture, yet supporting without injury a considerable amount of it. Without a pretence at any completeness, we give here the names of the most common plants which the author had occasion to observe at the roadside last summer. A great number of them are common to the meadows of England :—

Scrophulariaceæ: Veronica Chamædrys, Germander Speedwell.
„ *Rhinanthus major*, Yellow rattle.

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Umbelliferæ:	*Anthriscus silvestris*, Chervil.
Leguminosæ:	*Trifolium pratense*, or Red Clover.
Labiatæ:	*Salvia pratensis*, or Meadow Sage.
„	*Ajuga reptans*, or Common Bugle.
Leguminosæ:	*Lotus corniculatus.*
Boraginaceæ:	*Phyteuma orbiculare*, or Rampion.
Caryophyllaceæ:	*Agrostemma (Lychnis) githago*, or Common Corn-cockle.
Melanthaceæ:	*Colchicum autumnale.*
Dipsaceæ:	*Scabiosa Columbaria.*
Ranunculaceæ:	*Thalictrum*, or Meadowrue.
„	*Trollius europæus*, or Globe-flower.
Compositæ:	*Bellis perennis*, or Daisy.
„	*Leucanthemum vulgaris.*
„	*Taraxacum officinale*, or Dandelion.
„	*Crepis biennis.*
Ranunculaceæ:	*Ranunculus acris*, or Yellow Bachelor's Button.
Rosaceæ:	*Potentilla reptans*, or Cinquefoil.
„	*Sinapis arvensis*, or Charlock.
Gramineæ:	*Phleum pratense.*
„	*Briza media*, or Quaking-grass.
„	*Dactylis glomerata*, or Cock's-foot grass.
„	*Poa annua*, or Meadow-grass.

These plants flourish abundantly in the meadows, which are well cultivated, drained, and manured, all the stones being collected and placed in heaps. We will now consider those growing higher up in the pasture-lands, upon the flank of the mountains.

(2) *Pastures* (*alpage or "montagnes"*).—The pasture-lands, which are the most exterior tracts of country and leased by the landowners to the cattle-breeders, are divided into "montagnes," each containing a châlet and land sufficient for grazing about forty cows and double that number of smaller cattle. The most characteristic plants in this region, which stretches from a height of 3600 feet to the highest summit of the Jura, 5169 feet, are the following:—

Alchemilla alpina, or Lady's mantle.
Potentilla aurea, or Alpine Cinquefoil.
P. tormentilla, or Sweet Heather.
Poa alpina, or Meadow-grass.
Heracleum alpinum, or Parsneps.
Anemone narcissiflora, or Narcisse-flowered Windflower.
Dryas octopeda, or White Dryas.
Bupleurum ranunculoides.
Hieracium villosum, or Hairy Hawk-weed.
Gentiana acaulis; G. lutea; G. verna; G. germanica; G. campestris.
Anemone alpina.
Androsace lactea, or Milkwhite Androsace.
Helianthemum œlandicum, or Rockrose.
Cœloglossum albidum, or White Orchis (*Gymnadenia*).
Ranunculus alpestris, or Alpine Crowfoot.
Erigeron alpinus, or Alpine Fleabane.
Nigritella angustifolia, or Vanille Orchis.
Aster alpinus, Blue Alpine Daisy.
Gymnadenia conopsea, or Fragrant Orchis.
Anthyllis vulneraria, or Kidney vetch.
Plantago media, or Plantain.
Thymus Chamædris, or Thyme.
Calamintha alpina.
Onobrychis sativa, or Sainfoin.

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Campanula rotundifolia, or Bluebell of Scotland.
Dianthus Carthusianorum, or Pink.
Rhododendron ferrugineum.
Crepis succisæfolia, or Hawk's-beard.
Centaurea montana, or Corn Blue-bottle; *C. Jacea*.
Achillea millefolium, or Milfoil.
Polygonum viviparum.
Rumex arifolius.
Sonchus alpinus.
Carex sempervirens.
Phleum alpinum.

The pastures are of different qualities. They may be more or less strong, more or less woody, more or less damp, and so on, and in consequence their vegetation varies considerably.

(3) *Zone of Forests.*—After meadows and pasture-lands, the largest part of the country is wooded, and covered with a considerable variety of species of arborescent and herbaceous vegetation. It has been noticed that meadows and pastures, once abandoned, are quickly overgrown with shrubs and woods which, before the colonisation of the region in the sixteenth century, must have covered the whole territory. The red fir (*Abies picea*) most largely predominates, and tends more and more to supplant all other arborescent species. *Abies pectinata*, or white fir, is considerably scattered, and seldom constitutes a compact group. Among other coniferæ, the most commonly met with are *Abies excelsa*, or Norway spruce-fir, *Pinus mughus*, or *P. pumilio*; *Taxus baccata*, or the yew; *Thuja occidentalis*, *Juniperus communis*, and others.

Among deciduous trees, the most largely spread is the *Fagus sylvatica* or common beech, which seems well adapted to the dry soil, and is to be found in considerable numbers on the skirts of the fir woods, and even in their very hearts. In the great fir woods of Risoux, however, the beech possesses only a secondary importance as an underwood. This forest, which is reputed to be the largest in Western Europe—it is certainly the largest in Switzerland, which possesses at the present moment 1,930,000 acres of wood, or 18·9 per cent. of its total area—extends for about twelve miles in length, and preserves many of the characteristics of a virgin forest, there being almost no roads and very few traces of the activity of man. In every season of the year it is steeped in the most profound silence, and in its almost ideal solitude one may walk for hours and days without meeting a human being. Here the *Abies excelsa* attains a height of from 65 to 96 feet, the growth of this species being so close that under their cover there is but a twilight even in the midst of a sunny day. The forest is hardly penetrable, and here and there in the depths lie enormous trunks, prostrated by storms or advanced age, and lending their rotting and decomposed tissues to the formation of innumerable plants of an inferior order, and new generations of the same giants. Seeking for light, and also probably in consequence of the heavy masses of snow which they have to support during the winter, their long branches usually slope towards a ground thickly covered with underwood, numerous species of ferns, moss, and other cryptogams. Among deciduous trees and shrubs may be mentioned:—

Oleaceæ: *Fraxinus excelsior*, or Ash.
Ulmaceæ: *Ulmus montana*, or Wych-elm.

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Salicaceæ:	*Salix caprea*, or Willow; *S. incana; S. grandifolia.*
„	*Populus tremula*, or Aspen; *P. alpa*, or *abele.*
Aceraceæ:	*Acer pseudoplatanus*, or Sycamore Maple.
„	*A. platanoides*, popularly Plane (as in Scotland).
Rosaceæ:	*Spiræa aruncus; S. ulmaria; Sorbus aucuparia*, or Rowan-tree; *S. aria*, or Beam-tree.
Betulinæ:	*Betula pubescens; B. intermedia; B. nana; B. alba* (very rare).
Papilionaceæ:	*Cytisus alpinus; C. laburnum.*
Caprifoliaceæ:	*Lonicera xylosteum*, or Honeysuckle; *L. alpigena; L. nigra.*
Vacciniaceæ:	*Vaccinium myrtillus*, or Bilberry; *Vitis idæa.*
Thymelaceæ:	*Daphne mezereum.*
Cupuliferæ:	*Corylus avellana*, or Common Hazel.
Rhamnaceæ:	*Rhamnus catharticus*, or Common Buckthorn; *R. frangula*, or Alder.
Saxifragaceæ:	*Ribes alpinum*, or Gooseberry; *R. grossularia.*

Several of these trees, and especially the sorb, linden-tree, poplar, willow, aspen, birch, elm, and others, are planted in gardens and at the roadside, but they thrive only where they are sufficiently protected against wind. As to the herbaceous plants growing in forests, their number of species is already less considerable than that in meadows and pastures, the conditions for obtaining light being less favourable, and the competition between the species less intense. The most characteristic plants found in the wood are:—

Galium silvestris.	*Hypericum dubium*, or St. John's Wort.	*R. platanifolius.*
Digitalis lutea, or Foxglove.	*H. quadrangulare.*	*Dentaria digitata*, or Purple Toothwort.
Angelica silvestris.	*Prenanthes purpurea.*	*Dianthus superbus*, or Fringed Pink.
Campanula glomerata.	*Thalictrum aquilegifolium*	*D. silvestris.*
C. rapunculoides.	*Ranunculus aconitifolius.*	
Geranium sylvaticum.		
G. Pyrenaicum.		

(4) *Xerophilous Vegetation.*—This fourth group of plants consists of those which favour scant moisture and grow chiefly among the more or less naked, calcareous rock, exposed to the full heat of the sun. This xerophilous vegetation requires less than 10 per cent. of water, and the species belonging to it are far less numerous, and therefore more valued than those which grow in the pastures. As there are very few naked rocks and dry sandy hills in the country, amateurs of rock-plants endeavour to produce them artificially in so-called Alpine gardens among rockeries. The following are among those met with:—*Erinus alpinus*; *Valeriana montana*; *Rhododendron*; *Gentiane nivalis*; *Geranium sanguineum*; *Ranunculus alpestris*; *R. Thora*; *Papaver alpinum*; *Draba aizoides*, or Whitlow-grass; *Saponaria ocymoides*, or Trailing Soapwort; *Silene quadrifida*; *Cerastrium arvense*, or Mouse-ear Chickweed; *Antenaria margaritacea*; *A. duria*; *Poamontana* (*nemoralis*). There are besides numerous plants of the natural order Saxifragaceæ, which grow among rocks. The most common, which are met with on dry sandy soil, are:—*Linaria vulgaris*, or Toadflax; *Epilobium spicitum*; *Ononis ripens* and *O. procurrens*, or Rest-harrow; *Sedum acre*, or Stonecrop; *Calluna*

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vulgaris, or Common Heather; *Cyparissias*; *Setaria glauca* and *Braya supina*.

(5) *Peat-bog, Marsh, and Aquatic Plants.*—In concluding this section, it remains for us to pass over in rapid review the hydrophilous vegetation. In the first place, there are the peat-bogs and the wet, spongy, mountain-bogs, with their characteristic and Arctic vegetation. The peat-bogs have a considerable extension in the lower part of the valley-bottom, where the waters have a difficulty in escaping, and here we find the association of two different species of pine—*Pinus montana* and *P. uncinata*; three species of birch—*Betula pubescus*, *B. nana*, and *B. intermedia*; *Vaccinium uliginosum*, or Bog Whortleberry, *V. oxycoccus*, or Marsh Whortleberry; *Calluna vulgaris*, or Common Heather; and different sedges such as *Carex limosa*, *C. heleonaster*, *C. pamiflora*, etc. Regarding the real aquatic plants, which inhabit the lakes, rivers, and spongy mountain bogs, a distinction must be made between those emerging and those immersed. Of the former the most commonly met with are:—Reeds—*Phragmites communis*; clubs or bulrushes—*Scirpus lacustris*; horse-tails—*Equisetum palustre*, *E. limosum*; club-mosses—*Lycopodium inundatum*; and cotton-grass—*Eriophorum vaginatum*, *E. angustifolium*; different sedges, such as *Carex ampullacea*, *C. panicea*, *C. stellulata*, *C. leporina*, *C. limosa*, *C. pulicaris*, *C. filiformis*, *C. glauca*; many rushes, such as *Juncus obtusiflorus*, *J. lampocarpus*, *J. conglomeratus*; and very similar to these, *Luzula multiflora*, *Schœnus albus*; two British species—*Phalaris arundinacea*, or Reed Canary-grass, and *Molinia cœrulea*; three species of *Utricularia*, and three species *Droseræ*, etc. Among the immersed plants we have:—*Potamogeton perfoliatus*, or Pond-weeds; *Ceratophyllum submersum*, or Hornwort; *Tenorium scordium*, or Water-germander; several *Zizania*, etc., to which may be added the *Nuphar lutea*, or water-lily.

Lapiez (*Karrenfelder*).—We have given the characteristic plants of the five principal associations, and it now remains to indicate some particulars concerning the flora met with on the "lapiez" or "rascles," as they are called, which occupy extensive tracts in Savoy, and in the region we are studying—that situated near Seches des Amburneux. This is a plateau of about two square miles, consisting of desiccated fissured and fractured calcareous strata, almost horizontal. There is no special flora proper to lapiez, although it affords peculiar biological conditions, and harbours a very curious association of different species of plants usually widely dissociated. At the side of such plants as *Trollius europœus*, *Dianthus superbus*, and other hydrophilous forms, there are to be found characteristic xerophilous species, such as *Erinus alpinus*, *Asperula cynanchica* and others. In spite of the small altitude (4265 feet), the lapiez of Amburneux possesses many plants of an Alpine species, such as *Anemone narcissiflora*, *A. alpina*, *Serratula monticola*, or Saw-wort, *Carex sempervirens*, and others which are not to be found in the adjacent pastures. There are also in the lapiez many southern, or almost southern, plants, such as *Daphne Cneorum*, *Hypericum Richeri*, *Cerinthe alpina*, and *Canista pilosa*, or Green-weeds. The coexistence at the same place of plants so heterogeneous appears to be due to the physical peculiarities of the ground, and the very unequal distribution of light and moisture.

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General Character and Origin of Local Flora.—What particularly distinguishes this is the heterogeneity, for notwithstanding a certain number of species appertaining to the Prealps, there are disseminated on the northern declivities of M. Tendre, La Dôle, and other ranges, hidden in shadowy hollows and cool retreats, some true Alpine plants of psychrophilous and hydrophilous species, such as *Pinguicula alpina*, or Butterwort; *Sibbaldia procumbens*, well known in Scotland; *Salix arbusuela* and *S. reticulata*; *Gnaphalium Hopeanum*, or Cudweeds; *Rhododendron rugineum*; *Pedicularis foliosa*, or Lousewort; *Dryas octopetala*; *Alsine verna*; *Viola calcarata*; *Epilobium anagallicipolium*, or Willow-herb; *Soldanelle alpina*; *Senecio Duronicum* (Groundsel); *Edwlweiss* (only on the Dôle); *Veronica alpina*; *Bupleurum ranunculoides*, etc. Besides these two principal groups, there are a number of species proper to the south, and generally absent in the Central Alps, such as *Herianthemum vulgare* (Rockrose), *Hypericum Richeri*, *Anthyllis montana*, or Mountain Kidney Vetch; *Rosa pimpinellifolia*, *Scrophularia Stoppei*, *Ranunculus Thora*, *Daphne Cneorum*, etc. This last, which is a purgative plant, known in England by the beautiful name of garland-flower, and but seldom met with in other parts of the Jura, is a native jewel of the Joux valley, where it is to be seen adorning the calcareous rocks with its lively rose flowers, which grow in bunches, and are valued for their fragrance. The plant itself is a small shrub, with branches creeping on the ground, naked on their lower parts, but leafy near the summit. The leaves are small and smooth. Regarding the question of origin, it had long been supposed that the flora which we have just examined came originally from the Valais, but this is opposed by the fact that many species common to the southern Joux are absent in the Valais, and now the most probable theory, and that most favourably regarded by botanists, is that the Joux valley, as well as all the southern Jura, was invaded after the glacial period by the flora of the Outer and Central Alps.

Animal Life.—If there be any direct proportion between the amount of vegetation and the mass of animals grazing or otherwise consuming plants, we must in our case take into account domesticated animals before those living at liberty. Among the last there are certainly many rodents, crickets, molluscs, and other creatures destructive of vegetation, but it is to the excellent Swiss cattle, which graze five months each year on the pastures, and for the remaining seven consume hay in their stables, that we owe the maintenance of a balance between vegetable and animal life. The Joux valley, once entirely covered with pine forests, may have contained, as some fossiliferous remains indicate, a considerable number and variety of animals. This is far from being the case now. We may mention the Common Marten and Fox, *Mustela putorius*, or Polecat, and the Ermine and Common Weasel; *Meles vulgaris*, or Common Badger; and *Capreolus caprea*, or Roebuck, which is becoming very rare. As already mentioned, there are many genera of rodents, among which are *Sciurus vulgaris*, or Squirrel; *Lepus timidus*, or Common Hare; *Myoxus avellanarius* (Dormouse) and *M. nitela*, and a number of insectivores; *Talpa europæa*, or Mole; *Sorex araneus*, or Shrewmouse, *S. fluviatilus*; *Erinaceus europæus*, or Common Hedgehog. The hare, which is the largest of the

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Swiss rodents, is already very rare. The dormouse is very common, and lives chiefly upon grain and fruits. The mice—*Arvicola amphibia*, and especially the field-vole, *A. agrestis* and *A. arvalis*—are a great nuisance.

Avifauna.—As behoves these high altitudes, the bird-life inhabiting them is very interesting and varied, constituting a delight to the country. Especially numerous are the incessorial birds—Laniidæ—*Pica caudata*, or Pie; *Lanius excubitor*, or Shrike; *L. rufus*, or Woodchat, which inhabit the forest, and live on mice, frogs, and insects. In the forest we meet more agreeable birds of the dentirostral family Sylviadæ, such as *Saxicola rubetra*; warblers, *Sylvia rubecula*, or Robin-redbreast; *S. hortensis*, or Garden-warbler; *S. atricapilla*, or Black-cap Warbler; *S. phœnicura*, or Redstart; *Phœnicura tithys*, or Black Redstart; and *Accentor modularis*, or Hedge-sparrow. Here also we find numerous kinds of small titmice such as *Parus major*; *P. cœrulus*, or Blue Titmouse; *P. caudatus*, or long-tailed; *P. cristatus*, or crested; and *P. atta*, or black. There is also the Marsh Titmouse. About ten species of finches live in the forest. They are—*Coccothraustes vulgaris*, or Hawfinch; *Loxia curvirostra*, or Crossbill; *Pyrrhula rubicilla*, or Bullfinch; *Coccothraustes chloris*, or Greenfinch (which is rare); *Emberiza citrinella*, or Yellow-hammer; *Pyrgita domestica*, or Common Sparrow; *Fringilla cœlebs*, or Chaffinch (which remains the whole year); *F. montifringilla*, which also remains during the winter; *Carduelis vulgaris*, or Goldfinch; and *Fringilla linotta*, or Linnet. On the fields and pastures live thrushes, larks, and swallows. The four species of thrushes are—*Turdus merula* or *Merula vulgaris*; *T. torquatus*; *T. viscivorus*, or Missel-thrush, which remains the whole year round; and *T. pilaris*, or Fieldfare. The family of larks is especially numerous, and represented by five species—the *Alauda arvensis*, or Sky-lark; *A. crestata*, or crested; *A. arborea*, or Woodlark; *Anthus pratensis*, or Titlark; and *Anthus arboreus*. The swallows are also very numerous, myriads of them performing swift evolutions in the air every autumn before their departure. Fine species are—*Hirundo rustica*, or Chimney Swallow; *H. urbica*, or House-martin; *Cypselus apus*, or Swift; and *Caprimulgus europœus*, Goat-sucker, which is very rare. On the meadows and pastures are to be seen walking in troops members of the family Corvidæ—*Corvus corone*, or Common Crow, which is a constant denizen of the country. Accidentally may also be seen *C. monedula*, or Jackdaw; also *Garrulus glandarius*, or Jay, which, however, prefers the woods.

We have as yet not mentioned raptorial birds, which are less numerous and certainly less dangerous to the world of small insectivorous birds than their real enemy the domestic cat, which lives in every house and hamlet. Among diurnal raptorial birds may occasionally be seen: Kites, *Milvus regalis* and *M. niger*; Goshawk, *Astur palumbarius*; Buzzards, *Buteo vulgaris* and *Pernis apivorus*; Kestrel, *Falco tinnunculus*; Peregrine; and even an Eagle, *Circus harrier*. To the nocturnal raptors belong four species of Owls, viz.: *Strix flammea*, or Barn-owl; *S. nyctea*, or Snowy-owl; *Syrnium stridula*, or Ivy-owl; and *Otus brachyotos*, or Short-ear Owl. It is affirmed that *Bubo maximus* or Great Owl may also be seen, though very seldom.

The list of principal birds is not yet exhausted, there being consider-

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able extents of water and marshes which have their particular winged visitors. On the sides of streams are to be seen *Motacilla Yavrelli*, also *M. alba*, or Dish-washer, and *M. suprea*, or Wagtail. In the marshes there are Crakes and Herons; *Gallinula chloropus*, or Waterhen; *Rallus crex* and *R. porzana*, *Ardea cinerea*, *A. alba*, and *Ciconia alba*; also several Sandpipers, *Tringa cinglus* and *Totanus hypoleucus*. Several coots and snipes frequent the lake, such as *Fulica atra* and *Scolopax gallinula*. On the lakes in winter are to be seen Black-headed Gulls (*Larus ridibundus*); Greylags (*Anser ferus*), Common Mallards, Common Teals (*Querquedula crecca*) remaining all the year, Common Pochards and Goosanders (*Fuligula ferina* and *Mergus merganser*). For sporting purposes there are several kinds of Grebe: *Podiceps cristatus*, or Great-crested Grebe; *P. auritus*, or Slavonian Grebe; *P. minor*, or Dabchick; and *P. griseigena*. For hunting on dry land, among the woods and bushes, there may be mentioned among Columbacei and Gallinacei, viz.: *Columba livia*, or Rock-pigeon; *Coturnix vulgaris*, or Quail; *Perdix cinerea*, or Partridge; and even *Tetrao urogallus*, or Capercaillie, which is becoming very rare.

Fish.—Fishing does not constitute a profession, although there is abundant prospect for anglers in trout, pike, lotes, tenches (only in the lake Ter), perch, and gudgeon, or *Gobio fluviatilis*. When these fish are not to be tempted, there is provided an abundant substitute in the much-esteemed crustacean *Astacus fluviatilis*, or Crayfish, which abounds in the Orbe. Of other crustacea we know of none in the country, with the exception of water-fleas—*Daphnia* and *Polyphemus stagnorum*.

The animal sub-kingdom of Mollusca is largely represented, no lake in Switzerland, perhaps, being so rich in fresh-water *Polyzoa* as the lake of Joux. Their study, however, does not enter into geography. On the land one meets a great number of slugs and land-snails. Of the latter the two best-known species are the *Helix aspersa* and *H. pomatia*, which last is beginning to be cultivated for food purposes. The common slug, *Limax agrestis*, does a great deal of harm, and the Batrachians are also very numerous. After rain on a summer day, one may come across on the road near a lake myriads of frogs, directing themselves to or from the water.

Insect Life.—Passing over Spiders, Mites, and other orders of Arachnoidea, we may in concluding this section say a few words regarding the insects which so largely outnumber every other kind of living creature upon the earth, and force themselves upon the attention. Without being a plague, the insects in the country are rather more than less numerous than in other places, this being due to an abundance of water and vegetable food, decaying vegetable matter, the presence of cattle, and the vicinity of dung-yards, stables, and cesspools to the habitations. Thus we have insects everywhere, in or out of doors, in the fields, forests, meadows, marshes, and peat-bogs; innumerable insects, creeping or flying, buzzing or humming, droning or busy in their struggle for existence. Of these we can give only a very short account, it being difficult for us to enter into details, as the country has never been seriously explored by an entomologist. It may certainly, however, have its peculiarities. We learn, for instance, in the *Mittlei-*

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lungen der schweizerischen entomologischen Gesellschaft for April 1899, in a paper by M. Eric Morg, that the natural order of Dragonflies is richly represented in many localities of the Joux valley, and especially on the lake Ter, which he calls the paradise of dragonflies—"Libellen-eldorado." On viewing it he grows enthusiastic: "Hunderte von Cordulien und Aeschnen jagen vorbei und in dem Binsendickicht sitzen und schwirren umher tausende von Agrioniden." The author quoted gives three species of *Sympetrum*, three of *Cordulia*, three of *Æschna*, five of *Agrion*, and twelve more of other Libellulidæ.

Considering only the number, the natural order of *Diptera* (Flies and Fleas) is by far the most important. It is said that as insects outnumber all other creatures, so do Diptera outnumber all other insects. One is not at all difficult to persuade upon this point, when assailed on some fine summer day by Gnats, Bot-flies, House-flies, Crane-flies, Snipe-flies, and particularly annoying Gad-flies. Among other Diptera there are also numerous Threadhorns or Midges, Hawk-flies (*Asilidæ*), Honey-suckers (*Bombyliidæ*), Hovering-flies, Warble-flies, so noxious to cattle, *Tabanus*, assailing horses, and *Anthomyia Brassicæ*, which are so very destructive to cabbages.

The most numerous insects of other natural orders found in the country are mostly inoffensive beetles (Coleoptera), and Hymenoptera, to which belong Saw-flies, Gall-flies, Wasps, and Bees, which are exceedingly numerous. Ants and beetles infest the forests, the rich black soil of which, with the enormous masses of fine leaves, is favourable to their multiplication. Among the Orthoptera there are numerous Grasshoppers and Crickets, with several curious Mantids or Praying insects. Among the Plectoptera there are myriads of Caddis-flies and May-flies (*Ephemera vulgata*) sticking to the clothes, penetrating into eyes and ears, and, on the summer evenings, filling the air in clouds. Then there are Stone-flies (*Perla bicaudata*), which are used for trout-fishing, a few species of Hemiptera, which we prefer to leave without further enumeration; while to gladden the eye, and partly to reward one for the suffering inflicted by their congeners, we have numerous and splendid butterflies, and among them the largest and most dominant family of Nymphalidæ. Here one may admire *Pararge egeria*, *Vanessa Io* or Peacock Butterfly, and *V. antiopa* or Willow Butterfly; while among the less agreeable moths we have Owl-moths, Hawk-moths, Agaristidæ or day-flying moths, etc.

Inhabitants.—We will now connect the preceding account of the physical features, vegetable and animal life of the Joux valley with the history of its inhabitants. It may already be presumed that such a country, which required so much labour to adapt it to the needs of a civilised community, could not have been easily inhabited nor could the colonisation of it have succeeded at once. This fact proves the people who have conquered it to have possessed sterling qualities.

According to tradition, the first man to dwell in the country, probably in the sixth century, was a hermit named Dom Pontius, who built his hermitage on the north side of the lake of Joux. With his death, however, the country, then covered with impenetrable forests, relapsed into its solitude. Six centuries later, a noble yet humble pilgrim called

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S. Norbert, barefoot and clad in sheepskin, arrived on his way to Rome —all roads led to Rome in those days—but at the eastern shore of the lake of Joux he was seduced by the severe beauty of the site and profound solitude, and built a monastery, "Maison Dieu." He must certainly have had companions, and these pious men soon succeeded in obtaining at the hands of Ebald, Sire of La Sarrah and Granson, the gift of the lands they occupied, and thus became proprietors of the then so little valued valley. The monks, increasing in number, established a tilt-hammer forge and blast furnace, constructed various buildings, cut the woods, and cleared the land. This colonisation began at the end of the fifteenth century, and the monks maintained their vast dominion till 1536, when Claude Polleus, the last abbot, abdicated and embraced reform in order to establish himself as administrator of the former monastery's welfare, in the name of the Berne government, which had just established its rule with the reformed church over the Vaadtland.

In 1590 the population of the valley numbered 53 families. During the next twenty-five years it but slightly increased, but in the first half of the eighteenth century it had attained a total of 1360 souls. At the beginning of the present century this number was above 2000, and it more than doubled during the next seventy-five years. Since then it has remained almost stationary at about 5500. The actual density of population is 34 to 1 kilometre; the mean annual birth-rate is 25 per thousand, and the death-rate 16 per thousand. The natural increase by excess of births should thus be 0·3 per cent. yearly, but in fact, in consequence of emigration, it is only 0·012 per cent. The average death-rate is as follows: 20·1 per cent. under one year; 5·6 per cent. from one to fourteen; 33 per cent. between fifteen and fifty-nine; 15 per cent. from sixty to sixty-nine; 15 per cent. from seventy to seventy-nine; and 13·3 of an age above eighty.

The mean annual number of marriages stands: contracted, 40·5; dissolved, 31. The total number of married couples is 950, and the total number of children under fifteen, 1700. Out of 100, 27 die from diseases of the respiratory organs; 13·5 from those of the digestive organs; 9·5 from those of the nervous system; about 7 from those of the circulatory organs; 5 from those of the kidneys; 9 from cutaneous diseases and diseases of the genital organs; 8 from marasmus (old age), and about 5 by violent death.

The Sanitary State is very satisfactory; the most frequent maladies are those of the respiratory organs and neuralgia. A baneful effect is in some cases produced by consanguineous unions. For every 1000 inhabitants there are 40 people above seventy. Out of a population of 5527 persons, there are 2 above ninety; 11 above eighty-five years of age; 31 above eighty; 70 above seventy-five; and 101 above seventy.

Character.—The most striking features in the popular character are calmness, deliberateness, assiduity in work, sobriety, and politeness. Very reserved in their manners, the people have a tendency to mistrust, and even between friends in domestic relations they never say "yes" or "no," but something between both. Generally honest, they love money, and work hard to win it, but they are not greedy of gain, and rather

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modest in appreciating the value of their labour. They know how to spend their money as well as make it; are liberal in their expenses, enjoy comfort and even a certain luxury, and are pleased to see their wives and children neatly attired. The customs and manners may be considered as rather patriarchal, the aged parents maintaining authority.

The inhabitants are of Gallic and German origin, constituting generally a well-built, good-looking people, of rather short stature, but hardly ever stout; blond complexion, blue eyes, and frank and open bearing. There is a number of pretty and even beautiful women, neatly and tastefully attired, and with a noble bearing which does not betray the slightest trace of clownishness or vulgarity which one would naturally expect to meet with in such a remote mountainous country. The children are lively, healthy, and spirited, and are well clad and carefully attended to. We give some photographs of people in various degrees of age who were born in the country from indigenous parents. There may certainly be some shadow to this sunny picture, for misery is never absolutely excluded from any human community, but the sunny aspect greatly predominates.

Instruction.—It is certainly to their political liberties, blended with good instruction, that the people owe most of their good qualities. Instruction is the object of the greatest care in every community. There are 22 good schools, with at least 750 pupils, in which the instruction is obligatory for those from 7 to 15 years of age. Several penal dispositions have been sanctioned against parents who retain their children from school, but these have never been called into resource, as the pupils attend with great regularity through wind, storm, and rain. Besides 22 primary schools in which the teachers are mostly graduates, there is an Industrial College for the children of both sexes up to 16 years of age, where mathematics, natural history, English and German, sketching and painting, are taught. The vacations are somewhat short, extending to six weeks in the summer and two weeks at Christmas and New Year. There is also a natural history museum, six libraries, and "cercles de lecture." The result of all these efforts is already very important, and exercises a beneficent effect upon the progress of industry, so that the people may already be considered as cultured and industrial. They have certainly their weaknesses: they freely criticise each other, and are fond of gossip, but this does not impair in the least their sense of steadiness nor prevent them engaging in many useful works where combined efforts are necessary. Thus they have founded many useful societies—musical, choral, industrial, religious, scientific, etc., in which efforts are made to cultivate good taste and raise generally the conception of life.

Industries.—The people of the Joux Valley are eminently clever and industrious, and by far the most important industry is that of the manufacture of watches. Half of the inhabitants are watchmakers, and the market in this respect serves as the financial barometer of the valley. In this industry it competes with several other localities in the Jura, such as St. Croix, La Chaux-de-fonds, Locle, Les Brenets, but for a superior kind of watch, "montre de précision," it has acquired a distinction of its own,

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numerous artists in the craft being engaged in manufacturing the finest watches with small movements of 4, 5, and 6 lines, and most complicated chronometers. The history of the gradual improvement in the watch industry is very interesting, but we have no space to devote to it. Introduced in 1750, after various attempts at cutlery, lace-work, musical bells, automatic toys, etc., it passed through several dangerous crises to the position it now occupies. Firmly established and seemingly prosperous, the manufacturers do not, through lack of funds or other reasons, attempt the manufacture of the watch-cases, contenting themselves, to their great prejudice, in preparing only the internal workings. The produce of watchmaking was one million francs fifty years ago; it must be several millions now.

Lapidary Work.—In some connection with this industry is the art of polishing and engraving garnets and rubies, which, introduced in 1712, flourished for a time, but is now declining, the total produce being about 200,000 francs.

Cattle-grazing and Cheese-dairies.—The second industry of importance is the making of cheese (gruyère) and butter. The first, which is exported to Turkey, Greece, and America, is produced to the extent of about 100,000,000 lbs. avoir. (9920 lbs. avoir., 9000 quint.), valued at about 500,000 francs. The rich pastures, which occupy about 61 per cent. of the whole area, form an admirable grazing-ground for cattle, maintaining about 6500 head, with several sheep and pigs, from 1st June to 15th October. With regard to agriculture proper, it is quite insignificant. Several small patches of land dispersed among the grass-fields are tilled and sown with oats and barley, but the grain seldom matures, and is mown down while yet green.

Exploitation of Forests.—The forest industry is the oldest, the first saw-mill being erected on the Lionne by Abbaye at the beginning of the twelfth century. Thirteen saw-mills, moved by water and vapour, are now busily engaged in preparing planks and boards. Formerly a great deal of charcoal was prepared, but was eventually restricted as ruinous to the forests.

There are several other industries, such as horticulture, pisciculture, apiculture, exploitation of peat-bogs, etc., but these have only a local importance. The ice-making upon the Lake Brenet is an exception, and for the means of exporting the ice into France the branch railway from Vallorbes to the Pont was constructed. There is also an important razor manufactory at Sentier. Of a great number of medicinal plants, only the *Gentiana Entes* is largely made use of for the extraction of a liquor.

Villages and Hamlets.—The seats of these various industries are distributed throughout a dozen large villages, about double this number of hamlets, and several hundred detached or isolated farms and châlets. Among the villages the most important are:—Pont, at the northern end of Lake Joux; Sentier, at its southern; and Brassus, the terminus of the railway inaugurated last year (1899). These three villages are, in fact, small orderly towns, with electric light, numbers of good shops, small hotels, coffee-houses, and stately buildings, each village with its particular charm and individual stamp. The general view of the valley upon

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emerging from the tunnel of Epoisats on the railway from Vallorbes is very beautiful. One suddenly beholds a vast expanse of blue water, in which, as in a mirror, are reflected the green, woody hills, grey crags, and the neat villages and farms that frame it. The buildings one meets everywhere are spacious, with two stories and divided into two parts, the one, built of stone, being destined for habitation, and the other, built of wood, being used for storage and the protection of cattle and horses. In every house there is a corridor for the purpose of communication between the rooms, which are kept very warm in winter. Everywhere there is the stamp of comfort, from the cosy parlour on the ground floor to the neat bedrooms upstairs. Attached to each house there is an orchard and flower-garden, together with a poultry-house sheltered usually under a provision of finely-cut wood-chumps for fuel. There are no dogs, but cats are very numerous. On the windward side (west) the walls of the houses are covered with "ancelles" or wood-tiles, which are applied in five or six ranges, while the roofs are protected with plain and pan tiles, slates, iron, and wooden slabs. The "châlets," situated amidst the pastures, and occupied only in summer by the herdsmen, are built in a simpler and coarser fashion, are one-storied, and roofed with stone slabs and ashlars. In many of them one finds large stone chimneys, the flues of which are almost as wide as the fireplace, and are used for the fumigation of pork. Nigh to every house there is also a spring of excellent water, many having this water conducted into the house itself; but, to dull the picture, here also are heaps of dung and kitchen refuse, useful for manuring the land, but perfuming the air disagreeably. There are many excellent roads, fit for carriages, walking, or cycling.

Conclusion.—Though far from having exhausted the interest which this small country presents, we are forced to conclude. With a praiseworthy record for progress behind, it has certainly a great deal to attain; but such as it is, it stands an instance of what a human community, favoured by a healthy climate, good instruction, and liberal institutions, may do to realise happiness and well-being at an altitude of above 3280 feet in a seemingly inhospitable region.

THE COMMERCIAL RESOURCES OF TROPICAL AFRICA.

By EDWARD HEAWOOD, M.A.

Read at the Geographical Section, British Association, Bradford Meeting.

THE considerations put forward in the present paper have to do merely with a particular aspect of the wide subject of African commercial development—a subject far too wide to deal with in its entirety within the limits of a single paper. The two principal questions that arise, when we think of the possibilities of a new country from the point of view of trade, are of course, firstly, to what extent that country may supply a market for the manufactures and other exports of the countries

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which hope to benefit by such trade; and secondly, what resources does the country possess which may enable it to supply commodities in exchange. It is almost entirely to the second of these that attention is here directed, but a few preliminary general observations may help to clear the way for its examination.

With an area more than six times as great as that of our Indian Empire, the whole of Africa showed in 1898 a total volume of maritime trade but little in excess of the amount enjoyed by that one dependency of the British Crown. But even this statement does not bring out to its full extent the scanty commercial movement of the great bulk of the continent. If we divide Africa into two broad sub-divisions, putting on one side the older countries of the extreme north and south (in the north Egypt, Tripoli, Algeria, Tunis, and Morocco, and in the south the Cape Colony and Natal with their commercial dependencies), and on the other the whole remainder of the continent, *i.e.* broadly speaking, that portion which lies within the tropics, we find that the countries of the former category, which make up less than a fifth of the whole area, account for at least seventy per cent. of the total African trade; while Tropical Africa, with an area of some nine millions of square miles—more than the whole of North America—has little more than one quarter of the whole, representing an annual value certainly not exceeding £30,000,000. Of this relatively small sum, about £7,000,000 falls to the two small islands of Mauritius and Réunion, thus leaving to the great bulk of the continent an annual trade of little over £20,000,000, or about a sixth of that of the Indian Empire. It will be well to glance briefly at the causes of this small commercial activity, in order to arrive at some conclusion as to the permanence, or the reverse, of existing conditions.

The reasons for the present smallness of African trade may be grouped as, firstly, historical; secondly, geographical. As has often been pointed out, it was greatly to the disadvantage of tropical Africa that the first discoveries of its shores were but incidents in the prosecution of a more engrossing and important object—the discovery of a road to the Indies. In their eager striving to reach that much-sought goal, the old navigators could give no thought to the countries that lay between, except in so far as they afforded points of defence and refreshment on the route. In the sudden opening to Europe of two-thirds of the habitable globe it was natural that some portions of the newly discovered countries—not necessarily the least valuable—should have to wait to receive the attention they may have intrinsically deserved. But there were other reasons for the neglect which fell upon tropical Africa. The political condition of the African peoples, split up as they were into numberless small sections without cohesion, was such that no powerful empires existed to tempt the avarice of adventurers or afford protection to traders; nor were there any indigenous industries to supply articles of export. To these causes must be added the slave-trade, which caused Africa to be regarded rather as affording an aid to the development of other tropical countries than as in itself a field of enterprise. Geographical facts again tended in the same direction. The massive form

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of the continent, with no inlets of the sea, and few navigable rivers supplying access to the interior, long limited the dealings of Europeans to the veriest fringe round the coasts, while the extreme unhealthiness of these prevented the permanent settlement of white men and placed another impediment in the way of the development of African trade.

The ultimate action of such causes as these on the commercial history of a country may best be seen by a study of some other region to which the enterprise of European nations has been longer devoted than to tropical Africa, and which therefore may serve as an example of the fortune which may be anticipated for the latter in the future. Brazil probably supplies the closest parallel from many points of view with tropical Africa that can be found anywhere. It too, at the time of its discovery, was peopled by a variety of tribes with little political cohesion, while its physical aspects are to a great extent identical. Its forest-clad lowlands find their nearest counterpart in the great forests of the Congo basin and other parts of West Africa, and its central highlands have many features in common with those of Central Africa. Although possessing in the Amazon basin the best system of inland water communication which exists anywhere, this basin is just the part of its surface which has longest remained undeveloped, while the rest of the country presents an outline quite as unbroken as that of Africa. Its other great rivers, the Tocantins and San Francisco, have been of little service as highways to the interior, and like the African rivers, were little explored previous to the present century. Its chief comparative advantages have been, firstly, the absence of the extreme unhealthiness of West Africa, which has permitted its settlement by the nations of South and even Central Europe; and secondly, and more important still, the start which it gained through the attention attracted to it as a part of the newly discovered Indies of the fifteenth and sixteenth centuries. That, in spite of many drawbacks, Brazil has so far advanced as to possess at the present day a total trade some three times as great as that of Tropical Africa, justifies the anticipation that a brighter future may be in store for the latter, given natural resources capable of supporting an increased export trade. To this question attention must now be given.

In considering the resources of a new country like Tropical Africa, we have nothing to do with industrial products, which elsewhere, as in India, form no inconsiderable item in the exports. Although the old idea that the tropics are necessarily unfitted to be the home of important industries has in modern times been shown to be more or less mistaken, there are many reasons which place Africa at a particular disadvantage in this respect. As has been already said, there are no native industries of importance with the exception of the cotton-weaving in the Central Sudan, while the unhealthiness of the country and the absence of large deposits of coal will practically preclude the introduction of industrial undertakings by Europeans. The resources to be considered may be classed as (1) minerals, (2) animal and vegetal products. As has been lately pointed out by Dr. Mill, the former class, being necessarily

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exhaustible, cannot be considered an asset of lasting value for the development of new lands. The main reliance must be placed on the animal and vegetable products, which being continually renewed run no risk, in the majority of cases, of eventual exhaustion. They may again be sub-divided into, first, jungle products, produced without the intervention of man; secondly, cultivated products. Jungle products are not necessarily exhaustible, but in the absence of suitable measures to ensure a constant supply are liable in time to fail, or at least to suffer diminution; whereas cultivated products may be relied on to form a permanent resource, and are thus the most important group of all. This may be seen in fact from a study of the export list of any tropical or sub-tropical country which has advanced beyond the elementary stage of development. To take, for example, British India, no less than sixty per cent. of the total export trade is made up by the items rice, cotton, oil-seeds, wheat, jute, tea, and indigo. Brazil supplies another striking instance, for although rubber, perhaps at the present day the most valuable jungle product that exists, takes an important place in the list, at least sixty-six per cent. of the whole is made up by coffee, tobacco, cotton, and cacao.

Although, as has been said, jungle products are liable to diminution, they may in many cases be transferred, under cultivation, to the list of cultivated products.

A study of the present export list of the various countries of Tropical Africa shows that, generally speaking, that region has not yet passed beyond the jungle-product stage. Mauritius and Réunion are to be excepted from this statement, but these are of course in no way typical. Apart from the products of these islands, the only exports which in 1898 reached an annual value of £1,000,000, were rubber and the products of the oil-palm, both obtained principally (the latter exclusively) from the West African forest regions. Rubber headed the list with a total approaching £3,000,000, while palm-oil and kernels were exported from the countries round the head of the Gulf of Guinea (from the Gold Coast to the Kamerun) to a value of one and a half millions. Ivory, which so long formed one of the staple products of Africa, has fallen off of late years, and with the gradual extermination of the elephant must continue to do so. The greatest producing country, the Congo State, yielded in 1898 a value of less than a quarter of a million. All other jungle products, such as kola-nuts, timber, gum-arabic, gum-copal, beeswax, orchilla, etc., remain at comparatively small values. With the possible exception of timber, not much can be hoped for in the way of a further development of the trade in African jungle products apart from cultivation. Rubber, for which the demand at present exceeds the supply, is in danger of falling off owing to the reckless methods so often employed in its collection, while it may be doubted whether the demand for palm-oil would justify a greatly increased export.

It is from the cultivated products, among which such former wild products as rubber and kola-nuts may now be included, that any great improvement in the value of African exports must be looked for. A

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period of development of these has set in, practically within the past dozen years, and has already yielded hopeful results, although the enterprises have still hardly advanced beyond the experimental stage. There can be no doubt that the soil and climate of parts at least of Tropical Africa are eminently suited for the cultivation of coffee, cotton, tobacco, cacao, indigo, and possibly tea, several of which possess the special advantage of being indigenous to the continent. One of the earliest experiments in this direction, the cultivation of coffee in Nyasaland, has given most encouraging results, and the latest returns show a rise in the value of the export from £23,000 in 1898-99 to £62,000 in 1899-1900, the amount in the latter year reaching 1100 tons. The export of coffee from Angola and from Somaliland has reached much larger figures, but much of this is the produce of the wild shrub. In the Congo State large plantations have been established, the latest report on the subject stating that nearly two and a half millions of trees have been planted, while the approaching harvest is estimated to yield some 500 tons. Cacao also thrives admirably in the Congo State as well as in the neighbouring German colony of the Kamerun. In the former a beginning has been made by the planting of some half-million trees, while in the Kamerun further progress has been made, the amount exported reaching £15,000 worth in 1898. Tobacco has been grown at a profit, though in small quantities, in Nyasaland, the Congo State, and elsewhere. Rubber plantations have been established in many of the West African countries, including the Kamerun, Congo State, and Sierra Leone. For the encouragement of such cultivation experimental gardens have been formed in many of the colonies, and in addition to the products already mentioned various species of gutta-percha and vanilla, indigo, tea, etc. etc., are now being grown. Another product to which attention has been directed, principally in East Africa, is the *Sanseviera* and other fibre-yielding plants, though the uncertainty of the market for these renders success in this direction somewhat doubtful. In addition to these recent developments, mention should be made of older products such as oil-seeds, ground-nuts and cloves, which in certain districts form the staple exports. The two former are probably worthy of increased attention, but the market for cloves being limited there is even now a tendency to over-production in favourable seasons.

It may be well to glance briefly at some of the chief difficulties to be overcome in the agricultural development of Tropical Africa. First and foremost comes the difficulty of transport, for however well the soil and climate may suit the various crops, commercial success must, of course, depend upon the facilities which exist for placing the produce on the markets of the world. The difficulties on this head are well seen in the case of Nyasaland, a country moreover which is, comparatively speaking, fairly well supplied with means of communication in the water-route by the Zambezi and Shiré. As is well known, the navigation of the Shiré is broken during a short section by rapids, so that the transport system involves the employment at this part of native carriers. With the progress of coffee-planting during the last few years, the transport requirements have so increased that almost the whole available labour-

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supply is occupied at one part of the year in carrying loads between the Upper Shiré, Blantyre, and the lower river. In his report issued last August, Mr. Alfred Sharpe, the Commissioner, expresses the opinion that during the current year the whole labour-supply will not be sufficient to cope with the transport question. If this is the case where water-transport is available for the greater part of the distance to the sea, what must be the state of things where, as is so often the fact, no such facilities exist at all? The present activity in the way of railway construction will, if continued, largely do away with this difficulty. Already the Congo railway places thousands of square miles of fertile country within easy reach of the sea, though the high freights at present charged somewhat limit the usefulness of this mode of transport. Valuable results will likewise follow from the completion of the various other railways now under construction, in Sierra Leone, the Gold Coast, Dahomey, Lagos, Angola, British East Africa, and other European colonies and protectorates. The transport question may therefore be said to be in a fair way to be solved. With it is bound up to a certain extent the other great obstacle to be faced—the want of a sufficient labour-supply for work on the plantations. It was formerly held that the negro race, when freed from the compulsion to work, would never supply the labour requisite for the carrying on of extensive agricultural operations; and it has been the opinion of many that the only solution of the difficulty is the introduction of Indian coolies. But results have been obtained of late years which give ground for hope that the African negro may be found of more value for the development of his native country than had been imagined. In Nyasaland, *e.g.*, certain of the tribes, such as the Angoni, of Zulu affinities, have shown an unexpected readiness to work, and if not required for transport service, many thousands would be available for plantation work. In the Kamerun again, the latest German *Weissbuch* reports a promising disposition to work on the part of some tribes, whose labour has been utilised on the cacao plantations. With the creation of new wants, which can most easily be supplied by working for white men, the negro will no doubt gradually lose his repugnance to labour. The much-abused hut-tax has proved in some cases a valuable auxiliary in the process, as the natives have been induced to give their labour as a substitute for the tax, or at least to pay the tax out of the proceeds of their labour.

It therefore seems that some hopeful features are now observable in connection with the commercial development of Tropical Africa. It remains to be seen to what extent a market will be found for the increased output of plantation products which may be anticipated. Other tropical countries placed in an equally favourable position have not yet reached their limit of production, while the start which these have gained in the race must act more or less to the disadvantage of their younger competitors. A point in favour of Africa is, however, the modern tendency for each European nation to do an increasing proportion of its trade with its own colonies and protectorates. Those countries therefore—Germany, Belgium, Portugal, etc.—whose sole or most important tropical dependencies are in Africa, will give an impetus

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to the development of these by affording a market for the colonial produce supplied by them. Again, with an increased output of coffee from Nyasaland it may be anticipated that in the future Great Britain may derive a larger part of its supply thence, while the amount obtained from Brazil may be expected to diminish. It is satisfactory to read in Mr. Sharpe's report already quoted that, the quality of Nyasaland coffee being exceptionally good, the recent fall in prices has not affected growers in that protectorate so seriously as in many other coffee-growing countries.

In conclusion, it may be observed that in the future problem of the food-supply of the world, Africa, being a comparatively thinly peopled continent, may not improbably be called upon to do its share in providing a supply for the more densely peopled continents, though a general rise in the prices of food-stuffs would probably be a condition to be first fulfilled. This is, however, looking beyond the possibilities of the near future. Meanwhile it is probable that certain regions such as the shores of Lake Nyasa, which are eminently suited for rice-growing, may before long export that commodity for the supply of neighbouring regions less favourably placed in that respect.

A HISTORY OF SCOTLAND.[1]

By turns translator, poet, critic, journalist, mythologist, biographer, novelist, metaphysician, theologian—and in all these capacities a man of mark—Mr. Andrew Lang now challenges the verdict of fame as a serious historian. Fortunately for his fellow-countrymen it is the story of Scotland he has essayed to write, and for that task few could be more thoroughly equipped with knowledge or better qualified by natural gifts.

Prudently resisting the common temptation to speculate concerning the primeval inhabitants, Mr. Lang states with precision and lucidity the little that early Roman history has to say or suggest on the subject and that archæology has revealed. About the Celts, the Picts, the Scoti, the Norsemen, and the Saxons he has collected countless threads of fact, and has woven them together with admirable dexterity, and not less admirable reserve. In spite of a certain profuseness of bare statement, inevitable in any history, the narrative is always interesting—often engrossing. Here and there one comes upon a sparkling film that illuminates the sombre mass—a line of caustic fun that brings one in mind of the author in fields more frequent and familiar:—

'St. Margaret's son Edgar put out the eyes of his uncle, Donald Ban. For the family of a saint, that of St. Margaret behaved in a style remarkably mundane.

'English and Normans now flocked in and obtained the best. . . . The long process began by which English brewers, soap-boilers, and upholsterers sit in the seats of Macdonnells and Macphersons.'

Nothing could be better as a specimen of what may be called inferential history (surely as legitimate as Owen's construction of an entire skeleton from two

[1] *A History of Scotland from the Roman Occupation.* By Andrew Lang. 2 vols. Vol. I. W. Blackwood and Sons. Pp. xxvi+509. *Price* 15*s. net.*

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bones) than Mr. Lang's description of early life and early culture in Scotland, derived from the Lives of the Saints and archæological evidence. There is no picture of the period immediately before and immediately after the consolidation of the kingdom at all equal to it either in carefulness, comprehensive accuracy, or graphic representation. Generally, the author is lavish in notes, but here and there one finds no reference where reference might well be looked for. What, for instance, is his authority for the statement that most of 11,500 Danish yeomen in Lincolnshire had been driven by Norman cruelty and oppression to Scotland, where they became sires of a sturdy Lowland race? Proof of such immigration would be full of interest, and would throw a flood of light on the much discussed Scandinavian settlement of Scottish Border glens. There is, no doubt, much justice in our author's account of the high civilisation of the Scots prior to the death of Alexander III., in whose days there "wes sons of Ale and Brede, of wyne and wax, of gamyn and gle." But is it not going too far to say that when David I. was justifying his future record for "sair sanctship," Scotland "was perhaps more civilised than it has ever been since, where art is concerned"? Barring a few missals and charter-initials and an uncertain stone or two, there is not much "art" of that period extant. And even two hundred years later, when the stately fanes of Melrose, Kelso, and Dryburgh rose by the river Tweed, architecture is the only branch of art concerning which the remark would have been true. With patient pains and resolute research Mr. Lang traces the evolution of written law from traditional custom, the overlaying of Celtic and Saxon by Norman methods of rule and government, the consolidation of feudal and of ecclesiastical authority, the growth of the burgess element and the ever increasing influence of large towns. Such subjects do not lend themselves readily to grace of treatment; but it goes without saying that history was never recorded with so light a hand, yet firmly withal. Eschewing the sonorous sententiousness of Macaulay, Mr. Lang does not hesitate, when occasion offers, to lighten up the monotony of narrative by quip or jest—some light electric touch in his own inimitable way. Describing feudal Scotland, he says "the poor were probably hardier than the classes which now seem to live chiefly on stewed tea, bread, and cheap jam." Edward I. of England he sets down as a "strong valiant man, with a thread of the attorney in his nature," and "the faculty, invaluable to a moral politician, of being able to believe in the justice of his own cause, the flawless integrity of his own character and the excellence of his own aims"—a sentence to which many will doubtless impart a double significance. Of King John, Edward's pliant nominee,—"we know very little, but (perhaps especially, if he was over-educated at Balliol) he seems to have been the least Scottish of his competitors." One can see Mr. Lang's smile and hear his chuckle as he writes. On page 254 there are signs of hasty revisal—a confusion of "yets" and "stills," and, at the foot, two dates obviously wrong by 100 years. As a rule, Mr. Lang is not only impartial as between faction and faction within the realm, but makes a truly cosmopolitan estimate of the worth and character of the Scottish nation. When he comes to deal with the Scots Guard in France, however, he gives free rein to patriotism and lets himself go. It would be well were his panegyric to awake an echo across the Channel, where justice has never yet been done to the part played by her Scots allies in many famous victories of France. There are traces of a kind of personal predilection on Mr. Lang's part for King James III. in his chapter on that unfortunate monarch, for whose failures the historian's summing up is an eloquent, almost touching, apologia. And there are chinks in his cultivated impartiality through which one may discern other preferences as well as other dislikes. These, after all, but testify to the author's humanity. What true Scot,

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be he never so anti-prelatic or anti-Stuart by conviction, can hear "Wae's me for Prince Charlie" without being for the moment a Jacobite? Mr. Lang's pet aversions we should guess to be Henry VIII. and John Knox, whose shins he gives a sly kick, even as he turns them out of court with a verdict of not proven. "Katherine was finally sacrificed to the gospel light that dawned in Boleyn's eyes"; and again, "Everybody, Henry thinks, must see facts so conspicuous, though Henry himself did not see them till light dawned from the brown eyes of Anne Boleyn and her jewelled hair."

When on the moving canvas of his history the battle of Flodden glides into notice, Mr. Lang rises to the occasion and gives a vivid description of that "immortal defeat." "No battle lost by chivalrous folly was ever so well redeemed by desperate valour, and no fight since chariots charged on the plains of windy Troy has been so chanted." Mr. Lang only goes so far as to consider it "probable that Surrey's force was nearly as crippled as that which, with almost all its leaders dead, drew sullenly across the swollen and darkling fords of Tweed." But it is more than "probable." It is recorded that the town of Macclesfield, for example, was so reduced in consequence of the loss at Flodden that a brother of Lord Derby took advantage of its weakened position to encroach upon the rights of the remnant of its burgesses.

In James the Fourth's educational policy, and in a decree of his Parliament that all Barons and freeholders should have their sons educated in Latin, Art, and Law, Mr. Lang seems disposed to discern the first steps in the change which rendered the Reformation inevitable in Scotland. "The educational reforms of the reign were certain to end in the overthrow of the power of the church: . . . . when an educated generation of lay nobles arose, the prelates and their church were doomed to fall together; . . . to educate a new class is to transfer power and property, and the universities proved to be fountains of heterodoxy." Perhaps no better example of Mr. Lang's historical style can be given than his contrast of the causes and nature of the Reformation in northern and southern Britain:—

"This is not a topic on which it is easy to be impartial. Protestant historians have seldom handled it with impartiality, and their suppressions, glosses, and want of historical balance naturally turn into opposition the judgment of a modern reader. . . . The English Reformation began in the action of the Crown, and was carried through by the Crown, the new *noblesse*, the Bishops of Henry VIII. and the more wealthy and prosperous of the middle classes. . . . A Church was developed which worshipped in the ancient fanes, under the ancient order of bishops, in the translated words of the ancient service-books, or in others not less beautiful. The assistance of the arts was not always rejected; common prayer was deemed more important than political and doctrinal harangues from the pulpit. Monasticism perished: purgatory, prayer to saints, pilgrimages ceased to be recognised. There was a Revolution, but a Revolution which left many old things standing, and did not at once destroy all the pleasant popular holidays and practices which the ancient faith had consecrated to Christian use.

"In Scotland the Reformation began, not in the Crown, and not immediately from personal and political causes, but from rational criticism, developed in the ranks of the gentry, the junior branches of the great families, the Augustinian and Dominican Orders, some of the secular clergy and the wealthier burgessess. . . . The governing clergy of Scotland stood by the Cause. It is hardly fair to blame them for this, and hardly historical to regard them as infamously cruel because they carried out the law of the land and the coronation oath by burning theological innovators—just as Henry VIII. was doing in England; just as Presbyterian ministers on the strength of texts were presently to burn old women and (later) hang a premature Biblical critic. . . . The greed of the nobles, by starving the new Establishment made it democratic in tendency, while the adoption by Scotland of the republican theocracy of Geneva made the Kirk democratic in constitution. Ecclesiastical art, with its appeal to the emotions, was swept away. Preaching, doctrinal and political, tended to usurp in the Kirk the place of prayer and ceremony. The popular pleasures which an ancient faith had patronised

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were abolished. From a holiday and feast, Sunday was turned into a lugubrious penance. The priest's power to absolve, the mystical meaning of the Eucharist, vanished, and, in their place, the private miraculous gifts of ministers in prophecy, in healing and so forth, supplied the necessary element of the 'supernatural.' . . . The details of private life, the conduct of the domestic and foreign affairs of the State were subject to the censorship of preachers, some of whom believed themselves to be, and were believed to be, directly inspired. A tyranny unexampled was imposed on life and conscience and enforced by the civil penalties of excommunication—that is, 'boycotting.' The tyranny was a democratic tyranny, often exercised by rude men of low birth. Thus, of Churches which have a common name to be Christian, there could not be two so unlike each other as those which in England and Scotland were to arise from the ruins of Rome.

"The abuses of the mediæval Church had in Scotland risen to a perhaps unequalled height. Vernacular poetry and *fabliaux* had for ages satirised the vices of a celibate clergy, the system of 'pardoners,' the idleness of able-bodied monks, the luxury and ambition of prelates. . . . 'Every man takes up abbacies that may please, they tarry not till benefices be vacant, they take them ere they fall, for they lose virtue if they touch ground.' . . . The private lives of some of the clergy were as secular as the corselet of Archbishop Beaton. . . . One of the most extraordinary, and in its way diverting indications of clerical morals is obtained in a deed of obligation by the chaplain of the Altar of Corpus Christi in the Church of St. Michael at Linlithgow not to pawn the sacred plate, books, and vestments, 'to use no unreasonable excess,' and 'to have no *continual* concubine.' While some of the clergy were fierce and dissolute, they were also, with many notable exceptions, ignorant. . . . Greek they had none, nor Hebrew. . . . Catholics stood on the traditions developed by the Church under the constant guidance, as was alleged, of the Holy Spirit. The new men stood on the letter of the Bible, as the sole and sufficient inspired authority. . . . The tide in Scotland was turning against formulæ and traditions. The new learning could not find purgatory in the Bible, and if there were no purgatory, then all the money laid out on Masses for souls had been robbed. So, later, Arran came to think, and changed what few but he called his mind."

Mr. Lang, like Lord Salisbury, is a master of "flouts and jeers"; and lights his solid chapters up with flashes of sarcastic cynicism. "Magnus was cursed by women in the streets for blighting the crops with his evil eye, a theory of meteorological causation still entertained in the Highlands." "But the unhappy Jamys Pringle had revealed the plot, to the unfeigned regret of Norfolk, Dacre, Magnus, and, perhaps, Mr. Froude!" "The Covenanters, later, rejoiced in that pleasant phrase, 'the vomit of Toleration.'" "The natural indisposition of man to pay tithes, and the no less natural inclination of a priest to be married, seem to have been the original impulses which led David Stratilon and Mr. Norman Gourlay to inquire critically into grounds of doctrine." "Henry with his love affair and his divorce and his quarrel with the pope was now a brand snatched from the burning." "Wishart took pupils at Cambridge, and Tylney attests his unbounded charity, while admitting that some of his pupils(?) were anxious to kill him for his severity. Even the most unpopular tutors are seldom assassinated at the English universities." In regard to this famous Reformer, one cannot but think Mr. Lang too willing to make him out the very Wishart who went to England on a treasonable and unpatriotic errand. In this matter, there is more of the counsel for the prosecution than of the impartial judge. Even if the accusation were true, which is far from being proved, it was a fault outweighed by many noble qualities evinced as well during Wishart's active and scholarly career as in his last hours of agony at the stake. Unlike most of his fellow-sufferers, he was less a stubborn and fanatical bigot than a man of charitable temper and even of broad mind. His record at Cambridge and during the plague at Dundee is entirely to his honour; and if he showed uncompromising antagonism to Rome and to the luxurious and intolerant prelates of those days, who can blame him?

Truth to tell, the Scotland revealed by Mr. Lang is a most distressful country

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—at least during the period from Alexander's fatal fall at Kinghorn to the death of James v. It is a constant prey to discord, the basest intrigue, and the direst bloodshed. In those days ill fared the land that had a child for king—a calamity that befell Scotland reign after reign. In the sanguinary struggles for control during the sovereign's minority noble fought with noble, prince with prelate, pope with king, queen-mother with everybody. So honeycombed with dissension, so hard beset with turmoil and civil war was the little nation, that its survival as an entity through all these centuries is little short of a miracle. Indeed, nothing kept it together but a common hatred and distrust of England—the auld enemy; and even that was too often forgotten by selfish and greedy traitors, from the Douglas downwards. With infinite patience and infinite pains, Mr. Lang guides his readers through these labyrinths of plot, interplot, and counterplot. It is exhausting even to follow him, and one stands aghast at the thought of what it must have meant to gather and elaborate it all—to lick it into order and cohesive shape. Sometimes, indeed, one is tempted to ask if the broad aspect of history is not lost to some extent by such painstaking minuteness, and if it were not better left to histories of one reign or period. Yet it is certain that without the record of these shifting intrigues the book would lose much of its value and significance. It is a monument of determined industry—an industry which no confusion could appal and no intricacy discourage, even when, to use his own expressive phrase, "parties were fluctuating like blown sand." The result may be kaleidoscopic and perplexing, but these alternate combinations and estrangements are necessary in a true picture of the kingdom under the early Stuarts. One shuts the volume with a sigh for poor Scotland. Perhaps in his next Mr. Lang will show how out of the crucible came pure metal, purged of dross and clay, and how this never-ending battle and bloodshed, this turmoil, poverty and hardship, evolved the present race of Scotsmen, distinguished above every other for world-adaptability and enterprise. A new history of Scotland was a bold, almost a rash, challenge; but Mr. Lang canters out of the lists victorious from the first onset. In the second he will have to urge his steed over dangerous ground; the reigns of Mary and James are full of pitfalls. His countless admirers throughout the English-speaking world will turn to the new volume with whetted appetite. Meantime his fellow-countrymen stand indebted to him for this first instalment—a scholarly, honest, faithful, brilliant history of their native land during centuries most difficult to grasp and comprehend. Prophecy may be, as George Eliot said, the most gratuitous form of error; but there is little risk in saying that a better or more readable record of Scotland's past is not likely ever to see the light.

GEOGRAPHICAL NOTES.

EUROPE.

Geographical Teaching in Edinburgh.—Mr. William S. Bruce, F.R.S.G.S., Lecturer on Commercial and Industrial Geography at the Heriot-Watt College, has been appointed Lecturer on Geography by the Church of Scotland Education Committee to the Training College. There are about one hundred students attending this class, namely, forty men and sixty women. Work commenced on Wednesday, October 10, and forty lectures will be delivered during the winter session. Mr. Bruce resumed his geographical class at the Heriot-Watt College on Tuesday, October 2. There was a considerably larger number of students this year than last.

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The Marbles of Greece.—Professor Paul Chaix of Geneva sends us the following note, which he has received from a friend in Greece :—

The author of the following lines had, in October 1846, the honour of being present at a meeting of the Chamber of Deputies in Athens, and the great pleasure of seeing, sitting not far off on the ministerial bench, Constantine Canaris, the vanquisher of so many Turkish admirals, and the heroic avenger of Khios and Paros. The parliament then sat in a plain unpretending structure, which has since made room for a palace of white marble ; but the Hellenic navy have few brilliant deeds to boast of since the days of Canaris, Miaculis, Tombasis, etc.

The isle of Paros had in old times the honour of supplying Greek sculptors with marble of unrivalled beauty. The famous edifices of Athens were, however, built of marble quarried in Mount Brilettos or Brilessos, now called Pentelikos. Such was its abundance that many large edifices all over the continent, such as the colossal temple of Jupiter at Olympia, were constructed of Pentelic marble. Professor Lepsius calculated that these quarries supplied Greek builders with 400,000 cubic metres of marble in the palmy days of Athens and Rome. The quarries were confiscated by the imperial government of Rome, Pentelikos passing into the possession of Herodes Atticus, a friend of the Emperor Marcus Aurelius.

After supplying material for some of the Byzantine palaces, the quarries were neglected after the conquest of the city by the Turks. They were opened again in 1831, when King Otto raised the vast structure which is now the residence of Hellenic royalty. The work of quarrying was conducted by such crude methods, that a vast quantity of the precious material was wasted, and when I visited the quarries in 1846 they were choked up. Improved methods were adopted in 1861 by the architect Ziller, to whom the patriotic Baron Sina had intrusted the task of building the Academy of Sciences. The lower courses of this splendid edifice are composed of the limestone of the Piræus, and the upper of Pentèlic marble. This was cut into colossal blocks by a steel thread worked by machinery. For the building of the Academy alone 2500 cubic metres of marble were brought to Athens. Following in the steps of Phidias and Iktinos, Ziller was obliged to build two bridges and many miles of road in order that this material might be transported to the city. The next buildings to be erected were the Parliament House and the Central Museum.

Many houses in Athens, including that of Dr. Schliemann, have now an elegant front of white marble. Ziller has obtained a long lease of the quarries from the monastery of Penteli, which owns all the southern slope of the mountain. The number of workmen engaged in stone-cutting has increased from 80 to 500 during the interval from 1860 to 1896, and the yearly output is now 14,000 tons, or 5000 cubic metres.

Recently a strong Anglo-German association, under the management of Perino and Co., Berlin, has purchased marble quarries of large extent adjoining the old convent of Petrakir, west of Penteli. A railway from Athens to Kephissia has been prolonged eight miles to the large quarries on the northern slope of Pentelikos. Here Ziller has opened a new quarry close to the ruins of a chapel dedicated to St. Dionysios.

The saccharine marble of Pentelikos, not so translucent as the Parian, has, however, a very compact and fine grain, and withstands the disintegrating action of humidity and sudden changes of temperature. Hence the carvings on the Erechtheion are as sharp as ever. Owing to the presence of a small proportion of iron, centuries of exposure have covered the pillars of the temple of Theseus with a thin incrustation of light brown oxide.

The Perino Company has extended its enterprise to the island of Skyros, which

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it has purchased, and will no doubt soon bring to light the renowned Verde Antico of the island of Tino, and the not less precious Rosso Antico found on the peninsula of Cape Matapan.

Trade of Malta.—The annual report on the Malta Blue Book for the year 1899 was issued last month. The Chief Secretary states that the total revenue for 1899 amounted to £354,265, 15s. 2½d., being an increase on the year 1898 of £21,776, 15s. 1¼d., this amount being due almost entirely to the increased customs receipts, which amounted to £197,421, 5s. 9d., and formed the largest return ever reached from that source. A new item of revenue created last year by the Malta Revenue Order in Council, 1899, established a stamp duty on receipted bills and other documents, which enactment coming into operation on August 14, 1899, produced a revenue at the rate of £2500 a year. The increase in the customs revenue is due to the abnormal quantity of spirits imported in anticipation of the raising of the duty from 2s. 6d. to 5s. An increase in the importation of flour met a decrease in that of wheat. The general imports in 1899 amounted to £6,668,961, which shows a decrease on 1898 of £3,356,170, and of nearly five millions compared with the average of the five years immediately preceding 1899. Of the total imports, £976,300 is the value of goods actually brought into the island, and £5,692,631 of cargoes which touched at the port but were immediately re-exported in the same vessels. There is a decrease of £3,356,170 as compared with 1898, the loss being in the imports from foreign countries, those from the United Kingdom having increased by £94,313. The exports for 1899, exclusive of the produce of the island, were valued at nearly 5½ millions, of which £40,250 value of goods actually landed and re-exported, and £5,409,251 value of dutiable goods which merely touched at the port and proceeded in the same vessels. The shipping returns for 1899 show a falling off both in the number of vessels and total tonnage. There were two sessions of the Legislature during the year, and thirteen Ordinances received the Governor's assent. These deal with the landing and residence of aliens in the island, and concern themselves to prevent aliens of bad character coming to live in the island, and for their expulsion on their being condemned for any crime. A provision of this particular Ordinance makes the law retrospective in the case of aliens who have not resided at Malta for a period of three years or more. Ordinance No. III. authorises the head of the government to establish industrial schools similar to those used in England, and the necessity for which has long been felt. The criminal statistics of the island show a decrease in crime of a serious nature. The civil population of the islands for 1899 is estimated at 181,648, an increase of 16,611 on the census of 1891, and of 1320 on that of 1898. The birth-rate for the year was 37, and the death-rate 25·91. The existence of the plague on the shores of the Mediterranean has given a stimulus to sanitary matters. Hospitals, and observation and disinfecting stations have been organised and all necessary remedies and appliances procured. The total postal revenue for the year amounted to £14,397, being a decrease on 1898 of £1184. The total cost of postal service for the year was £13,743, a decrease on that of 1898 of £3187. The gross earnings of the railway for the year amounted to £7318, 4s. 10d., an increase of over £210 on the receipts of 1898. This undertaking progresses steadily and is expected to become more remunerative now that the line has been extended to Imtarfa Barracks, which was effected by driving a tunnel under Notabile at a cost of nearly £20,000. Regarding the pecuniary situation of the island, there is an absence of statistical information, outside of the returns published by the Government treasury. The value of landed property in the islands of Malta and Gozo is estimated at £4,500,500; the amount of money invested by local capitalists in British and foreign securities

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about two millions, giving an average return of 3½ per cent.; the amount of money deposited in the Government Savings Bank on 31st December last, £522,148, and in local banking companies about £100,000. Regarding the amount of deposits in private banks no estimate is available. The money in circulation is valued at £540,000, and that of jewellery existing in the island is already about £1,000,000 and is increasing very rapidly. Mr. Secretary Strickland observes in concluding that the Banking Laws are totally inadequate, that the issue of notes should be regulated by law, and all banks be required to declare the capital on which the gain of a certain percentage is declared.

The Paloutnotchnie Canal.—A telegram from Odessa, of October 5, states that this canal, situated at the mouth of the Danube and passing through Russian territory, is now officially declared open. It is noted that this canal renders Russian steamers independent of Sulina, the opening situated in Rumanian territory, and is therefore considered of great strategic importance.

Bulgaria. Chirpan-Nova-Zagora Railway.—A despatch from H.M. Agent and Consul-General at Sophia, dated the 18th September, states that the line of railway from the town of Chirpan to Nova-Zagora, has been sufficiently completed to be opened for traffic, and has accordingly been handed over to the Oriental Railways Company. That section between Chirpan station, on the Philippopolis-Adrianople main line, and the town of Chirpan, including a long bridge over the Maritsa, is not yet ready.

Russian Trade with Northern and Central Persia.—At a meeting held recently at Nijni-Novgorod Fair, of representatives of the largest manufacturing Russian firms, regarding the question of increasing the export of Russian manufactured products to Persia, several questions relative to the subject were raised. It was found that several firms had endeavoured to establish direct relations with Persian tradespeople and failed. The reason for this failure was attributed to the existing unsatisfactory economic condition of Persia for some years past, owing to which the cash sale of goods to Persian traders had become almost impossible, and credit transactions unsatisfactory, as it would not be accepted for more than twelve months, and even then was in no way guaranteed. The conclusion come to, therefore, was that the most trustworthy method of trade relations with Persia was the exchange trade formerly carried on by the Caucasian traders. Among other conclusions come to, it was found that the most important trade among manufactured goods to Persia was carried on in coloured prints (of the Adrianople pattern), this being due to a higher rate of return duty which gave this class of goods precedence over others; that the principal market at present for the sale of goods for Persia was Baku, and that the whole Russian trade with Persia was concentrated at Tabreez and Resht, whereas, operations with krans being effected only at Teheran, owing to the absence of branch offices at the two former places, traders were compelled to go 265 miles out of their way to deposit security for krans. The meeting did not arrive at any definite conclusions. With regard to this, a communication received at the fair a short time ago from the Russian Imperial Vice-Consul in Seistan states that the demand for Russian half-cloth of light sandy and coffee colours of every shade, also black, blue, and bright green colours, for fustian stuffs and prints, is so great that these goods have already made their way as far as Seistan, Afghanistan, and Beloochistan. The great demand for these goods is due to their superiority over Anglo-Indian, German, French, and Austrian stuffs, which do not suit the popular taste, but which the people are obliged to purchase owing to the scarcity of those of Russian manufacture. He also states that an Anglo-Indian merchant

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proposes to export Russian-made half-cloths and prints to India, where he anticipates they will have a great sale.

The official organ of the Ministry of Finance, comparing the interesting report of the Russian Vice-Consul in Seistan with the meeting of manufacturers, comes to the deduction that, on the one hand, Russian goods which find their way into Persia seemingly by themselves find on arrival a brisk demand, seeing that they are cheaper and more durable than foreign goods; and, on the other, that an Anglo-Indian merchant proposes to trade in these goods, yet Russian merchants complain that the cumbersome conditions of commercial relations with Persia prevent the development of exports to that country. It asserts, therefore, that the reasons which prevent the successful sale of Russian goods in Persia and its neighbouring eastern states is not due to the cause which the traders maintain, but to a certain amount of inertness on the part of the traders themselves, combined with insufficient knowledge of the local markets. It is hoped that the exertions of the Russian Vice-Consul in Seistan will serve as an example to a wise and conscientious activity on the part of the Russian agents in the East.—*Board of Trade Journal*, October 4, 1900.

ASIA.

The Chifu-Tsin-Tau Cable, which was laid between Chifu and Tsin-Tau for account of the German Government, is stated in a telegram from Berlin, of October 5, to have been opened for the transmission of messages the previous day, thus joining the territory of Kiao-chau to the international cable system.

The Federated Malay States.—Sir Frank Swettenham in his annual report on the Federated Malay States suggests the raising of a further loan of £500,000 towards the construction of a section of about 175 miles of railway from Seremban in Negri Sembilan to Johore Bharu, whence a short crossing by ferry-steamer and the Singapore railway (14 miles) would take passengers from Penang, right down the Malay peninsula to Singapore. The growing prosperity of these States, the financial position, the present price of tin, and the approaching completion of the railway construction now in hand, make the moment peculiarly favourable for an undertaking which has so much to recommend it, and would confer such manifest advantages on the Malay state of Johore and the colony of the Straits Settlements.

AFRICA.

Tripoli and the Sudan: A Trans-Saharan Scheme.—In the *Asiatic Quarterly Review* for October there is an article on "The Sultan and Central Africa," by Mr. S. H. Fitz John, which discusses the relation of Tripoli to the Sudan. He reviews the claims of the Sultan in the light of the saying, "To possess Tripoli is to command the Sudan," citing from *L'Exploratore*, January 1881, the words of Kohlfs, which gave currency to the thought, "Chi possederà questa terra sarà il padrone del Sudan." The most important part of these claims is concerning the territory between the Fezzan and Lake Chad, since the prosperity of Tripoli depends on its caravan trade with the Central Sudan, which is now menaced both by way of the Niger and the Nile. But the French in their desire for the unification of their African territories advance rival claims. It seems, therefore, to Mr. Fitz John that the political as well as the economic problem may be solved best by a Trans-Saharan railway from Tripoli along the coast to Khoms and Misurata, passing thence through Sokna, Murzuk, and Bilma to Lake Chad. This

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will tap the salines of Bilma. These play a most important part in the economic relations of the Sudan, but the cost of transport is so heavy that there is a possibility of the salt imported by way of the Niger driving the Bilma salt from the Sudan market. The commercial needs of Tripoli and the highway of trade between it and the Sudan can only be met by the facilities of communication which a railway affords. He believes also that a railway along the Tripolitan littoral to the east may ultimately form part, up to Sokna, of a North-African railway from Morocco to Egypt, passing through Zella and Aujila to Siwa and Alexandria. The Trans-Saharan scheme involves the consideration of the sovereign rights of the territory between the Fezzan and Lake Chad. Is it to be Ottoman or is it to be French? Which is to possess sovereign rights and which is to be satisfied with a right of way? As Tripoli has for centuries had the commercial ascendency in relation to the Central Sudan, Mr. Fitz John thinks that Turkey may well look for sympathy and support, and that no desire of France for the mere unification of her African possessions can justly be regarded as of sufficient importance to set aside the Ottoman right to maintain and develop the commercial relations of Tripoli and the Sudan. He notices the reports of military activity and missions, and recalls the fact, recorded in the *Journal of Von Bary* for August 1877, that the Tubu of Bilma had petitioned the Sultan to receive them under his protection and occupy their territory. If the Sultan has at last taken possession of that oasis, he will have secured the main highway from Tripoli to the Sudan. But this question concerns other states besides France and Turkey. Italy, in the spring of last year, "received assurance that no enterprise of England or France against Tripoli is to be feared either in the present or in the future, that nothing will be done to interfere with the trade routes between Tripoli and Central Africa. Now, the ivory that comes to Tripoli from the Sudan, is derived from Adamawa. If it is deemed necessary to connect Algeria with the Central Sudan it may well be deemed as necessary to connect Tripoli and Adamawa. Hence the Tripolitan Trans-Saharan becomes an international highway of commerce, and if the British railway from Lagos to the Niger is prolonged to Kano and to Kuka, this Trans-Saharan scheme becomes a Trans-African railway. As it is the aim of England to develop the commerce of the Central Sudan by way of the Niger, this Trans-Saharan scheme concerns her less than Italy, Germany, and Austria, with their Mediterranean ports; but her commercial relations with Tripoli may well lead England to consider this scheme, and support it if deemed feasible." In addition to these political and commercial considerations, this Trans-Saharan scheme receives support from the needs of the Hajj, since it will provide facilities for the pilgrims of the Central Sudan, all the more if a railway in connection with it is built to Egypt.—(*Asiatic Quarterly Review*, October 1900, pp. 282-299.)

Trade of Zanzibar.—The report on the trade and commerce of Zanzibar for the year 1899 was issued in August last. The acting Consul reports another satisfactory year for trade. Prosperous as was the year 1898, when it was possible by the organisation of the Customs department to check the imports and exports, the year 1899 has been still more satisfactory, the result being probably due to the same causes mentioned in last year's commercial report, viz., the famine in the interior of the mainland, and another large clove crop. The maximum rainfall in the course of one day amounted approximately to 15 inches, although the average rainfall for Zanzibar is only 66·69 inches. "The total value of the imports for 1899 amounted to £1,596,606, an increase of £41,536 on those of 1898, while those from foreign countries, excluding the neighbouring British, Italian, and German East African Coasts, exclusive also of those returns taken at the custom house of all

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produce which entered it from Pemba and Zanzibar Islands, amounted to £1,059,810, an increase of £46,982." From this it is clear that it is from foreign countries and not from Pemba and the adjacent mainland territories that the increase in the value of goods imported is due. Trade, therefore, is less in danger of being diverted by the growing importance of Mombasa and the opening up of the interior of British East Africa by means of the Uganda railway. The total value of the exports for the year amounts to £1,513,407, showing an increase on the previous year of £15,524. These figures include exports from the town to other parts of the Sultan's dominions. A decrease in the exportation of hides is noteworthy as a sign of increased prosperity rather than the reverse, since in times of want cattle are killed owing to scarcity of fodder. The total value of exports to foreign countries alone amounted to £663,421, a still greater increase than reported last year, the previous improvement having well-nigh doubled itself. India again stands first among the countries from which goods are imported, and first also among those to which they are exported. The value of goods exported to Germany is greater than in the previous year; a considerable falling off is noted on those of France; an increase of £27,372 on those of the United States; and an increase of £31,210 on those of Holland. The clove crop for the year has surpassed any other during the last ten years with the exception of 1895, which was greater by 7077 frasilas. This result has been obtained in spite of an abnormal quantity of rain and consequent floods. A new system of drying the cloves has been introduced, consisting of a number of square wooden boxes so constructed that each of them contains four sliding trays, one above the other. The boxes are supported by four short posts and roofed with dry cocoa-nut leaves. The cloves are spread upon the leaves until dry. At night or during rain, the four shelves can be closed at once, thus sheltering the buds at an immense saving of labour. An interesting discovery has recently been made, that the fruit of a tree growing principally at Dunga produces a white fluid, which, on being placed in boiling water, coagulates into what resembles an inferior order of gutta-percha. Samples have been forwarded to London, and should it be found to be worth anything, a large revenue may be derived from it. A solution of the labour difficulty would seem to lie in the employment of paid labour. This is where the Arab fails. In the case of European overseers, where money has been given for wages, labour is readily obtained. In the harbour, no alterations have been made in the buoyage of the reefs. Fourth order lights are to be placed at Ras Nungwe and Ras Mangopwani, which should reach Zanzibar from England this autumn. Steps are also being taken for the completion of the lighthouse on Chumbe Island.

The Geodetic Congress, at a meeting held in Paris on September 26, received an announcement from Sir David Gill, of Cape Town Observatory, that English experts were engaged in measuring an arc of meridian of 104° from the Cape to Alexandria, that they were passing, by permission, through German East Africa, and that five degrees had already been measured in Rhodesia and three and a half in Natal. The Congress warmly complimented England on her enterprise, and expressed a wish for international co-operation in order to complete the work by measuring an arc from French Congo to German East Africa.

M. Paul Blanchet, the head of the mission organised a year ago by the *Matin*, to study a route from the Hinterland of Algeria across the Sahara into the French Sudan, in anticipation of an eventual railway line for the development of the vast area recognised as French by the Franco-English treaty of two years ago, has died at Dakar from yellow fever.

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Italy and Abyssinia.—The question of the frontier between Erythrae and Abyssinia has been settled, Abyssinia recognising the Mareb-Belesa-Muna line which forms the present Italian frontier.

AMERICA.

Railway Construction in Mexico.—H.M. Consul in Mexico, in his last report on its trade, states that railway construction is proceeding favourably. In the State of Vera Cruz, the Vera Cruz and Pacific is going southward from Cordoba. This line has had to contend with many difficulties, notably the labour question. The Mexican Central is building beyond Ameca, towards the coast. The Cuernavaca and Pacific has crossed the Rio Balsas and is endeavouring to reach Acapulco. The Mexican Southern is being extended south from Oaxaca. Another line has been started from Chihuahua, which will ultimately reach the Pacific coast, and the National are building from Patzcuaro west towards Colima. These lines find, in a more or less degree, a difficulty in crossing the Sierra Madre Mountains, and all suffer from want of proper labour, the Mexican labourer appearing to have a rooted dislike for railroad construction work. This occasioned a great demand for foreign labour. A late experiment to import Italian labour proved a disastrous failure. Another attempt by the Mexican Central Railway to obtain negro labourers from the West Indian Islands aroused the enmity of the lower order of Mexicans, and resulted in serious rioting. Chinese, however, are arriving in vast numbers, and are well received, Mexico having recently concluded a treaty with China which gives to Celestials the same privileges accorded to other foreigners.—*Board of Trade Review*, October 4.

New Rubber District on the Amazon.—The German Consul in Payta-Piara (Peru) reports the discovery of large rubber forests on the Niera River, a branch of the Amazon, capable of being reached from the tobacco plantations by an eight-days' journey; that several German firms have organised an expedition to proceed to the interior, in order to secure the right to collect the rubber, and that a special road is being projected which will touch Iquitos, this being the shortest route through the Piara district.—*Board of Trade Review*, October 4.

The Trade of Barbados.—The report from the secretary for the colony for the year 1899 was issued in August last, and is a somewhat gloomy one. The year has been uneventful in commerce, unremunerative in agriculture and socially depressing. The total revenue for the year was £216,022; this amount exceeding that for 1898 by £33,340. The explanation for this lies in the fact that in 1899 the Imperial Government gave to the Colonial Government a grant of £40,000 to restore damage done by the hurricane in 1898. So that, with this sum deducted, the revenue for 1899 would have only reached the sum of £176,022, which is £6660 less than that for 1898. Customs show a decrease of receipts amounting to £2339, the result principally of a falling off in "tonnage and import dues." The Post Office shows a decrease of £1936, which is due largely to the adoption of the penny imperial postage. The total value of the imports of the colony amounted to £998,006, which, compared with 1898, shows a falling off to the amount of £60,879. The total value of the exports amounted to £845,590, which, compared with the year 1898, shows an increase of £76,359. The explanation of this lies in the fact that during a bad crop season the value of the sugar rises, thus showing a greater value, but a diminished quantity, of export produce. There is no appreciable change in the destination of the products, the United States of

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America taking by far the largest share. There are no mines other than the workings from which manjak is obtained. This is a bituminous substance which appears to be of increasing value, in as much as when in 1899 only 1026 tons were exported, valued at £4617, or averaging £4, 10s. a ton, in 1898, 1160 tons were exported, valued only at £2320, or averaging £2 a ton. The substance is constantly found, but not in sufficient quantity to justify a heavy expenditure. The veins are sometimes broad and promising, but, failing suddenly, have to be picked up again at much cost of dead work. Generally speaking, the manufactures of Barbados are insignificant. Seven rum distilleries were at work in 1899, distilling in the aggregate 254,286 gallons of rum of an approximate value (exclusive of duty) of 1s. 5d. per gallon. There is a sulphuric acid factory in the parish of St. James, the product of which is used in the manufacture of manures, the making of soda water, and the refining of rum. There is a large flying fish and general fishing industry, carried on mainly by the poorer classes, to whom fish is an important staple food for a large portion of the year. There are also two small whale-fishing ventures, the joint exportation of which, in 1899, amounted to 254 barrels of oil, compared with 193 barrels in 1898. The Botanical Station in its original small scale is still carried on by the colony, although everything of botanical importance is under the direction of Dr. Morris, the Imperial Commissioner of Agriculture. There are no land grants: the condition of the sugar industry is such that it is difficult to estimate the value of land. The Master of Chancery, who has great experience, is of opinion that the average value of plantation land for agricultural purposes is from £18 to £20 per acre. The population is estimated at about 192,000. Generally speaking, the public health for the year was good. In October and November an epidemic of diarrhœa and dysentery, especially among the poorer classes, caused mortality among those very young and very old. The total rainfall for the year taken at the Botanical Station was 49·55 inches, with 191 wet days, compared with 64·55 inches and 205 wet days in 1898. The lack of rain promised to be a very serious matter for the water supply of the colony, unless this year helped to restore matters to their normal condition. The mean barometrical pressure was 29·927, the mean temperature 78·9; and the mean velocity of the wind nine miles an hour, blowing E., E. by N. or ENE. for 216 days, E. by S. or ESE. for 52 days, N. or ENS. for 34 days, S., SE. or SSE. for 51 days, and SW., SSW., and in a south-westerly quarter for the remainder. The Anglican Church of Barbados suffered a severe loss by the death of Bishop Bree in January 1899. The Royal Commission in their inquiry recognised the need of fostering Canadian trade, and towards this end, the Imperial Government is granting a subsidy of £13,500 annually, and the Canadian Government has contracted to run a fortnightly line from Canada to British Guiana, calling at West India Islands *en route*. If the West Indies are to benefit by this, however, freights must be reduced to a figure which will admit of sugar being placed at Canadian refineries at the same cost as at those of the United States. There is a tendency in Canadian trade circles to cut out the United States trade in the West Indies, and the Canadians point out that it is on them that they must rely for the future. Although this is admitted, the West Indies cannot afford to lose their present profits, which principally come from the United States, for the sake of building up a Canadian trade in the future. In order to obtain additional fiscal advantages on this importation of sugar into the States, Barbados has had to readjust its tariff, giving favourable treatment to articles produced by the States. The Reciprocity Treaty approved of by Barbados is still under consideration of the United States Senate. Regarding emigration, the secretary states in his general remarks, it is impossible to overlook the fact that the population is becoming very

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large, while the resources from which it is fed are steadily diminishing. The encouragement of emigration among the poorer classes is, therefore, deserving of strong support by the legislature.

Emigration to the West Indies.—With regard to the above, a pamphlet just issued by the Emigrants' Information Office, containing general information for intending settlers in the West Indies, may be interesting. It contains a description of the various islands and the various reasons why they afford openings for emigrants. Small capitalists, it is affirmed, with, say £2000, will find that these colonies offer a fair prospect of earning a comfortable income, although, at first, they ought to have a year or two of experience regarding the peculiar methods of cultivation. The islands are suited to the cultivation of various kinds of fruits, such as bananas, plantains, cocoa-nuts (by the sea-coast), limes, oranges, etc., for all of which the market in the United States and this country is increasing. There is also grown tobacco, coffee, cocoa, arrowroot, india-rubber, fibre plants, and spices of some kinds. In some islands, as in Jamaica, cattle, horses, and mules are raised. Regarding professional employment, there are occasionally, though not as a general rule, openings in the larger colonies for members of the legal profession, together with a number of government, medical, and legal appointments, the vacancies of which are filled by the Secretary of State for the Colonies.

AUSTRALASIA.

The Cook Islands.—A telegram from Wellington, New Zealand, of September 29, states that Parliament had almost unanimously resolved on the annexation of the islands of Raratonga, Mangaia, Atiu, Aitutaki, and Mitiero, in the Harvey group; Palmerston, Savage, and Pukapuka; and Rakakanga and Manahiki in the Penrhyn group, and that the governor was proceeding in a warship for the purpose of annexation, the Premier following later. With regard to the above, a telegram from Sydney, states that on October 2, the Premier, Sir W. Lyne, in reply to a question in the Legislative Assembly, stated that preparations were being made to forward a strong protest to the Imperial Government regarding this annexation of the Cook Islands by New Zealand, and adding that New South Wales possesses a preponderance of trade with those islands, which would be diverted by the tariff which New Zealand would probably arrange. A similar protest by the Premier, relative to New Zealand's proposal to annex Fiji, was telegraphed to Mr. Chamberlain, who replied that the Imperial Government was at present unable to consider such a proposal. Later intelligence, however, received in a telegram from Raratonga, dated October 8, states that Lord Ranfurly, Governor of New Zealand, landed on that day, and at the unanimous request of the chief and people, annexed the Cook Islands, the British flag being hoisted during an impressive ceremonial, witnessed by two-thirds of the population.

NEW BOOKS.

Die Orkane des Fernen Ostens. By Professor Dr. PAUL BERGHOLZ. Max Nössler, Bremen and Shanghai, 1900. Pp. xii + 260.

This is a concise and clearly written account of cyclonic movements, with special reference to the storms of the Chinese and Japanese Seas. The book is divided into three parts. The first part with nine chapters discusses the general properties of cyclones; such as their origin, tracks, and the accompanying varia-

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tions of atmospheric pressure, cloud, and rainfall. The eight chapters of the second part are devoted to the question of storm forecasts, the motion of the clouds, the direction of the lower and upper currents, the indications of the barometer, etc., being all taken into consideration. The eighth chapter deals with phenomena which supply indirect forecasts, such as cirrus, haloes, scintillation of the stars, abnormal transparency of the atmosphere, and the colour of clouds. The third part deals with special or characteristic cyclones, and ends with a chapter on anomalies or apparent exceptions to the laws that generally regulate cyclonic action. The book is well printed, and contains many important tables and a few cuts in the text. An extremely valuable feature is the fine collection of nearly 30 charts illustrating the laws and properties of cyclones. These are not bound into the book, so that they can be studied with great ease when necessary.

The Western Rajputana States. By Lt.-Col. ARCHIBALD ADAMS, L.M.S., Administrative Medical Officer in Rajputana. Junior Army and Navy Stores, Limited, York House, Regent Street, London, 1899.

This handsomely got up volume presents to the reader an interesting account of the Western Rajputana States, viz. Marwar, or, as it is now more generally called, Jodhpoor, Sirohi, and Jaisalmir. It is, in fact, a gazetteer with unusual prominence given to medical and cognate matters. For most people, however, the principal attraction of the book will be its beautiful and numerous illustrations. To lighten the work, the author has added a brief history of each of the states, with pleasant dissertations on the flora and fauna to be found in each. He writes with the accurate knowledge gained from residence among and personal experience of all ranks of the people, and at the present time his observations on previous visitations of famine and plague have an unusual interest. The Rathor Rajputs of Marwar are thoroughly loyal subjects of the Queen Empress, and contribute two regiments of splendid cavalry to the Imperial service, sixty-five per cent. of which are horsed with Arabs. Their colonel, Sir Pertap Singh, A.D.C., G.C.S.I., has repeatedly visited England, and served in the last frontier campaign with General Lockhart.

Kleines Statistisches Taschenbuch uber alle Lander der Erde. Statistische Tabelle uber alle Staaten der Erde. Wien, Pest, Leipzig : A. Hartleben's Verlag.

These are the latest editions of the useful statistical publications issued by Herr Hartleben.

Vom Mittelmeer zum Persischen Golf durch den Hauran, die Syrische Wüste und Mesopotamien. Von Dr. MAX FREIHERRN VON OPPENHEIM. Zweiter Band. Berlin, 1900. Dietrich Reimer (Ernst Vohorn). Pp. 434. *Price* 10 *Marks.*

The first volume of this masterly work was reviewed at page 440 of vol. xv. of this Magazine. The present volume opens with the author's journey through Mesopotamia, of which he gives an ancient chart, whilst an excellent map by Dr. Richard Kiepert details the author's whole journey through Syria and Mesopotamia. Gifted with complete knowledge of Arabic, Dr. von Oppenheim was able to study thoroughly the Beduin Arabs, to whom he devotes a chapter and many illustrations, forming, perhaps, the most learned dissertation extant on this wild and widespread race. The ruins of Nimrud and Nineveh enable him to

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reopen an archæological field made familiar by the labours of Layard, whilst his description of the ancient Caliphs' city of Bagdad, which he entitles "Bardād," and whose population with suburbs he estimates at 200,000 (whereof 150,000 are Mohammedans), shows us the importance of the city as a modern commercial centre. "Admirably situated on the Tigris, Bagdad possesses an extensive trade. Its imports are mainly from Great Britain and India, and include cotton goods, metals, linen, clothing, etc. Austria-Hungary and Germany follow, and France is third. Most articles of luxury—furniture, lamps, and small-wares—come from Vienna. There are three British firms in Bagdad. Since 1894 a German house has been established there. German imports increase annually, and exports to Germany are steadily augmenting. The want of direct railway connection between Bagdad and its seaport Basra, on the Persian Gulf, has proved a great hindrance to the expansion of German trade here." The author trusts that "the day is not far distant when the railway line which Germany's awakened spirit of enterprise has secured from Constantinople to Konieh will be prolonged to Bagdad. Trade and commerce would then follow their ancient course, for, in olden days, the commerce of Europe to India and the far East passed through Mesopotamia." Dr. von Oppenheim's hope of a railway line seems likely soon to be realised, for the *Statesman's Year Book* of 1900 contains the following paragraph (page 1110): "A preliminary agreement of December 23, 1899, between Turkey and the German Anatolian Railway Company, stipulates for the construction and working of a railway from Konieh to Bagdad and Basra, to be opened for traffic within a period of eight years." The proposed Cairo-Basra-Karachi Railway might then take shape.

Égypte (Guide-Joanne). 3 vols. Maps, Plans, and Illustrations. Paris: Hachette et Cie, 1900. 20 *francs*.

The "Guides-Joanne" deservedly hold a high place in France, and this "Guide to Egypt," which has been revised by M. Georges Bénédite, Conservateur-adjoint des antiquités égyptiennes du Louvre, will increase their reputation. It consists of three small pocket volumes, well printed and amply illustrated. The first volume discusses "Généralités," such as (1) geography, agriculture, natural history, climate; (2) ancient Egypt; (3) Musulman Egypt; (4) Egypt of to-day. We may point out in this volume an article on Arabian art, by Max Herz Bey, as worthy of the attention of students. The second volume is devoted to Lower Egypt, and the third to Upper Egypt and Lower Nubia to the second cataract of the Nile. The maps, by M. L. Thuillier, accompanying these volumes leave nothing to be desired; and considering the various French Egyptologists of note who have assisted in perfecting this work, we confidently commend it to all desirous of profiting by their visit to Egypt.

Reisebilder aus Persien, Turkestan, und der Turkei. Von E. KAUDER. Breslau: S. Schottlaender, 1900. Pp. 359.

Herr Kauder here gives us his interesting experiences during a tour through Persia, Turkestan, and Turkey in 1895. He remarks: "The East is eminently conservative. Progress and change are not, as with us, allowed to interfere with the customs and circumstances of the people." Yet he benefited by the new steamship and railway lines which convey the traveller from Europe to Turkestan. This journey and an excursion to Persia form the contents of the work, which contains many excellent illustrations, and two maps showing the author's route.

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THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

ON THE DEPOSITS OF THE BLACK SEA.

By Sir JOHN MURRAY, K.C.B., F.R.S., Etc.

THROUGH the kindness of Professor N. Andrussow, of Juriew (Dorpat), we have received a series of the deposit-samples collected in the Black Sea during the Russian explorations in 1890 and 1891 in the steamships *Tschernomoretz*, *Zaporojetz*, and *Donetz*. We have submitted these deposits to careful microscopical examination and chemical analysis, and in this paper we propose to give the general results and detailed descriptions; but, before proceeding to do so, it will be advisable to describe briefly the general physical conditions in the Black Sea, and this involves a reference to the whole Mediterranean region.

The Mediterranean is filled with water having a very high salinity (3·85 per cent.), and the evaporation from its surface is enormous, for not only does it receive a large amount of fresh water from rivers, but it also exchanges denser water for fresher water with the North Atlantic Ocean and with the Black Sea. Dense Mediterranean water flows out at the bottom of the Straits of Gibraltar into the Atlantic, and has a great effect upon the salinity, as well as upon the temperature, of a large part of the North Atlantic basin, while fresher water flows into the Mediterranean at the surface. It has been estimated that for every 10,000 parts of Atlantic water entering the Mediterranean, 9334 parts of Mediterranean water must go out, leaving 666 for the water evaporated, and that the annual inflow of Atlantic water is equal to about 5000 cubic miles, while the annual outflow of Mediterranean water is equal to about 4667 cubic miles.[1] The mean specific gravity of the inflowing

[1] See Buchanan, "On the Distribution of Salt in the Ocean, as indicated by the specific gravity of its waters."—*Journ. Roy. Geogr. Soc.*, vol. xlvii. p. 72, 1877.

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Atlantic water is about 1·027 (3·6 per cent.), and that of the outflowing Mediterranean water is about 1·029 (3·9 per cent.).

A somewhat similar interchange of waters takes place between the Mediterranean and the Black Sea, through the Dardanelles, Sea of Marmara, and the Bosphorus, the dense Mediterranean water flowing into the Black Sea as an under-current through the Bosphorus, and the fresh Black Sea water flowing out as a surface-current. These two currents, and the manner in which they are to be accounted for, have given rise to some discussion and difference of opinion.

Admiral Makaroff writes:—

"The Strait of Bosphorus joins the Black Sea and the Marmora Sea. The Black Sea water has in it—roughly speaking—half the quantity of salt found in the water of the Mediterranean. The water of the lower strata of the Marmora Sea has the same composition as the water of the Mediterranean. The upper strata, say from 10 fathoms upwards, contain water of intermediate salinity between the water of the Mediterranean and the water of the Black Sea. This difference in the salinity of the water is the chief reason of the enormous double current of the Bosphorus. Let us imagine that at a certain given moment the level of both seas is at the same height. The pressure of the column of water in the Marmora Sea will be greater than that in the Black Sea; the difference would increase with the depth, and it would disappear at the surface. For this reason the water in the lower strata of the Marmora Sea rushes into the Black Sea, keeping close to the bottom. That rush of water after a certain time will raise the level of the Black Sea, producing a difference in the level of the two seas, which causes a superficial current to flow out of the Black Sea in the opposite direction to the under-current. Here we see distinctly that the principal reason for the double current is the difference in the salinity of the water, and should that difference in salinity cease the double current would be discontinued. The fact is that in the Black Sea evaporation does not exceed the quantity of water supplied by rains and streams, and this excess of fresh water maintains the difference of salinity in the water of the Black Sea and Mediterranean. The existence of double currents in the Bosphorus was known long ago, and Marsilli in 1681, in his letter to Queen Christina of Sweden, has described them. Later, they were somehow forgotten, and some interesting papers have been published, in which the authors try to prove that the double current was legendary. Rear-Admiral Sir W. J. L. Wharton, of your Navy (who is now at the head of the Hydrographic Office), was the first to show by direct observations that a double current existed in the Bosphorus. I was there a few years after him, commanding the stationary steamer *Taman*. I began to take observations of the specific gravity of the water at different depths, and I found out that the water forming the lower strata contained twice as much salt as the water of the upper strata; after this a double current was quite evident to me. In order to measure the velocity of both currents, I invented an instrument which consists of a propeller revolving on a horizontal spindle. A bell is attached to the propeller, the tongue of which is arranged to

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move on an axle in one direction; at every revolution of the propeller it strikes twice, and, as water is a very good conductor of sound, the number of revolutions could be counted through the bottom of the ship (provided the ship is not sheathed with wood) at all depths to which the instrument was lowered (40 fathoms). To this instrument I gave the name of fluctometer, and I used it during the whole year, lowering it on a wire rope with ballast of eighty pounds of lead attached below. Observations were made every two hours, and the specific gravity of water from every depth was taken at the same time when the velocity of the current was observed. The lower current is similar in many details to an ordinary river, while, on the contrary, the upper current differs much from an ordinary river, probably from the reason that, while the surface of it is falling gradually down, the bottom rises constantly. The difference of level of the Black Sea and Marmora Sea, calculated from the difference in the specific gravity of the water, I found for the month of July 1882 to be 1·396 feet."[1]

Admiral Sir W. J. L. Wharton writes:—

"In *Nature* for July 13, p. 261, is given an abstract of a paper lately read by Admiral Makaroff, of the Imperial Russian Navy, before the Royal Society of Edinburgh, on the subject of double currents, *i.e.* of currents in reverse directions in different strata of water in certain straits. Admiral Makaroff gives his opinion on the causes of these reverse currents, and as they are diametrically opposed to those that I hold, I think that it may not be uninteresting to give my reasons for differing from him. Admiral Makaroff considers that difference of density of the water is the primary and, indeed I gather he thinks, the only cause of these opposing currents; but he brings no evidence beyond theoretical considerations in support of his belief. Let us consider his instance of the Bosporus. In 1872, as Admiral Makaroff very kindly mentions, I made a series of observations on the under-currents in this Strait and in the Dardanelles, and showed that when the surface-water, of a very low specific gravity, was flowing from the Black Sea to the Mediterranean, the water in the lower strata of the Straits, of a high specific gravity, was running strong in the opposite direction. But the surface-current does not always flow in this direction. It is sometimes almost still, and on occasions the movement is towards the Black Sea. The lower strata respond, and are either also still, or move in the opposite direction. It is evident that as the Mediterranean water is always of a high specific gravity, and the Black Sea surface-water always of a low specific gravity, if the difference between them is the primary cause of the opposing currents, the latter would always flow in the same direction, and that as they do not in fact behave in this manner, there must be some other force at work. My observations soon led me to conclude that this force is the wind. The prevailing wind in the summer and autumn, in which I made my observations, is from the north-east. When it blew from this direction, the surface-current ran

[1] *Proc. Roy. Soc. Edin.*, vol. xxii. pp. 393, 394, 1899; quoted in *Nature*, vol. lx. pp. 261-263, 1899.

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towards the Mediterranean. When it was calm the water was in the Dardanelles, ordinarily, still, and in the Bosporus often so. When the wind came from the westward, the currents were reversed. I do not know how the deduction from these facts can be got over. I am quite ready to admit that the difference in specific gravity will cause a slow circulation in the direction in which the two currents ordinarily run, but in the face of their undoubted reversal under the circumstances which I have related, it appears to me that there can only be one conclusion. Admiral Makaroff is a close and indefatigable observer, and oceanography owes him much, but I cannot help thinking that in this instance his enthusiasm for densities has led him away. However, I shall be glad to hear reasons to the contrary, as I only desire the truth."[1]

Admiral Makaroff replied as follows:—

"In *Nature* of August 3, page 316, is given a letter from Rear-Admiral Sir William Wharton, in which he states that he is diametrically opposed to my opinion about the double currents in the straits. He says that 'Admiral Makaroff considers that difference of density of the water is the primary and, indeed I gather he thinks, the only cause of these opposing currents; but he brings no evidence beyond theoretical considerations in support of his belief'; further, in his letter, Admiral Wharton refers particularly to the double current of the Bosporus, of which I spoke in my lecture at the Royal Society of Edinburgh. I cannot leave unnoticed remarks from so distinguished a hydrographer, who, during his long work, has contributed so much to the advance of science. My researches about the Bosporus are published only in Russian, in a book named *On Exchange of Water between Black Sea and Mediterranean* (St. Petersburg, 1885). Should Admiral Wharton know my language, he would easily come to the conclusion that my opinion about double currents in the Bosporus is based upon the observations made in 1881 and 1882. I then invented an instrument for measuring the current at different depths [already described]. I am sorry that the limits of this paper do not allow me to give particulars of my observations, but I believe some of my deductions, worked out from direct observations, would be interesting to English readers. Mean velocity of the upper current, 3¼ feet per second. It varies from 0 to 10 feet per second in certain places. Velocity of the upper current diminishes with every fathom of depth. Limit between two currents close to the Marmora Sea is at 11 fathoms. It gradually goes down to 27 fathoms close to the Black Sea. Limit between two currents is influenced by winds and by barometrical pressure, but not very much. Lower current has close resemblance with the river. Its velocity does not vary very much. We never found anywhere lower current less than 1·84 and more than 3·22 feet per second. Mean velocity of the under current was 2·32. The upper current does not everywhere occupy the full breadth of the strait. It flows in some places under the north coast of the strait, and in other places under the south coast. Lower current also does not flow over the whole breadth, and occupies a certain part of

[1] *Nature*, vol. lx. p. 316.

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the bed of the strait. In my book I give a chart of the Bosporus, where I show direction of the upper and lower currents. A glance at that chart will show that there are places where both currents can be found, and there are places where the instrument will show the existence of only one of them, and in some places the explorer will not find either upper direct current or under current. Mean specific gravity of water entering from the Black Sea into the Bosporus is 1·0140. Mean specific gravity of water entering from the Marmora into the Bosporus is 1·0283. By upper current pass 370,000 cubic feet per second. By lower current pass 200,000 feet per second. Difference between these two figures being 170,000 feet per second is due to the excess of fresh water in the Black Sea. I hope that after reading these figures and deductions Admiral Wharton will change his opinion, and come to the conclusion that my idea about double current in the Bosporus is based, not only on theoretical considerations, but also upon direct measurement. Nobody can deny that the wind has a great influence upon the movement of surface water; but I hope that Admiral Wharton will agree with me that differences of specific gravity have also some influence upon the circulation of water in the seas generally and in the straits particularly."[1]

E. von Maydell,[2] in discussing this question, says the upper current is caused by the difference between the levels of the two seas, which, though not established by direct measurement, is inferred to exist in consequence of the difference between the densities of the two masses of water. Since the Black Sea receives annually from the large rivers which flow into it a greater quantity of water than is evaporated during the course of the year, it results that there is an absolute augmentation in its mass, causing a difference between its level and that of the Sea of Marmara, and so giving rise to the surface current. The under current is originated as a consequence of the difference in pressure—the more saline and heavier waters of the Sea of Marmara exercising, in comparison with the waters of the Black Sea, a greater pressure, bulk for bulk, than those of the Black Sea.

In the paper referred to, von Maydell also discusses the variations in the level of the Black Sea, based upon observations made at eight stations on the north and east coasts, spread over a period of eight to ten years. He concludes that there is not only a series of regular annual fluctuations, but also variations of a somewhat more permanent character, making themselves felt at irregular intervals, which last stand in intimate relation to the variations in the amount of precipitation in the countries drained by the river-feeders of the sea. As regards the regular annual fluctuations, the maximum is attained in the middle of May at the mouths of the great rivers, and in June at other places. The maximum rise is equal to from 3½ to nearly 7 inches above the mean level of the year, which is observed in July and August. There are two minimum levels

[1] *Nature*, vol. lx. pp. 544, 545.

[2] *Ann. d. Hydrographie u. marit. Meteorologie*, 1886, Theil. xii. (summarised in *Scott. Geogr. Mag.*, vol. iii. p. 77. 1887).

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in the year, in October and in February, when the surface falls from 2½ to 4 inches below the mean annual level, separated by a secondary maximum in December, which, however, fails to reach the mean of the year. In the case of the greater non-periodical fluctuations, it seems that from 1874 to 1879 the surface rose permanently to the extent of 7½ to over 14 inches. In 1880 it sank, rising again in 1881, and falling again in 1882. In 1878 a small secondary minimum was observed at the mouths of the Dniester and Dnieper, and in the Sea of Azov and the Straits of Kertch. These fluctuations correspond exactly with the fluctuations in the amount of precipitation on the drainage-basins of the Russian rivers, a heavy precipitation being followed by a rise in the level of the Black Sea, and a light precipitation by a sinking of its level.

It will thus be seen that the physical and biological conditions in the Black Sea are most peculiar, a large body of dense water being introduced into the deeper parts of the sea, and remaining there in an almost stagnant condition, the vertical circulation being limited to the upper strata of comparatively fresh water. The result is that life, except perhaps in its lowest forms, is entirely absent throughout the greater depths, where there is an abundant formation of sulphuretted hydrogen, and, in the deposits on the floor of the Black Sea, chemical precipitations of calcium carbonate and of sulphide of iron take place. Several papers [1] have been published, mostly in Russian, dealing with the results of the Russian investigations, and it will be interesting here to collect the information as to the temperature and salinity of the water, and to give the views expressed regarding the past condition of the Black Sea.

Generally speaking, the Black Sea forms a basin with steep sides and flat bottom, attaining a maximum depth of 1227 fathoms in the centre of the basin where the coasts of Asia Minor and the Crimea approach each other. Below the 100-fathoms line the slopes are generally steep, the most rapid descent being usually found between 700 and 800 fathoms, beyond which, down to the greatest depths, the slopes become very gentle. The 100-fathoms line is found at a con-

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[1] Spindler and Wrangel, *Résumé des observations hydrologiques faites dans la mer Noire et la mer d'Azof pendant les expeditions de* 1890 *et* 1891. St. Petersburg, 1899.

Skalovsky, "Des conditions physico-géographiques du bassin de la Mer Noire sous l'influence du Bosphore" (in Russian, title only in French): *Mém. Soc. Technique Imp. Russ. à Sébastopol.* St. Petersburg, 1897.

Collection of hydro-meteorological observations in various seas, including the Black Sea and Sea of Azov in 1897 *and* 1898 (in Russian). St. Petersburg, 1900.

Andrussow, three papers in Russian published by the Imp. Russ. Geogr. Soc., St. Petersburg, tom. xxvi. and xxviii.: "On the necessity for deep-sea investigations in the Black Sea"; "Preliminary account of deep-sea soundings in the Black Sea, 1890"; "Some results of the Tschernomoretz Expedition: on the origin of sulphuretted hydrogen in the waters of the Black Sea."

Andrussow, "Einige Resultate der Tiefseeuntersuchungen im Schwarzen Meere": *Mittheil. d. k.k. geogr. Ges.*, 1893, p. 373.

Andrussow, "La mer noire": papers of the International Geological Congress, St. Petersburg, 1897.

Marmora Sea: Expedition of the Imp. Russ. Geogr. Society in 1894, containing papers by Spindler, Andrussow, and Ostroumow, with *résumé* of the hydrological researches (in French) by Spindler, St. Petersburg, published by the Society (tom. xxxiii. No. 2), 1896.

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siderable distance from the coast opposite the Straits of Kertch, and in the north-western part of the sea, where the rivers pour out large quantities of fresh water charged with sediment, the Danube being the most important in this respect.

The waters of the Black Sea cover an area of about 119,000 square geographical miles (or, according to Andrussow, 360,850 square kilometres), and the area of land draining into it is about 692,000 square geographical miles, or together 811,000 square geographical miles. The contour-lines of depth (as shown in the accompanying map), based upon the latest information available, were transferred to an equal-surface projection map, and the intervals between the contour-lines were measured by the planimeter, with the following results:—

0 to	100	fathoms,	41,000	sq. g. m. or	35 per cent.
100 ,,	500	,,	11,000	,,	9 ,,
500 ,,	1000	,,	23,000	,,	19 ,,
1000 ,,	1200	,,	38,000	,,	32 ,,
over	1200	,,	6,000	,,	5 ,,
			119,000	,,	100 ,,

From these figures we have calculated the cubic mass of water contained in the Black Sea and Sea of Azov to be about 108,000 cubic miles, and the mean depth works out at about 600 fathoms (3599 feet).[1]

The Russian observations in the Black Sea were made in 1890 from 27th June to 23rd July, and in 1891 from 17th May to 11th June, and again from 4th to 27th August, so that by combining the results obtained in the two years we may form a good idea of the physical conditions during the summer season.

Temperature.—The temperature observations show that in summer the temperature falls rapidly from the surface of the sea down to a certain depth, which varies from 25 to 50 fathoms; the minimum temperature is generally found nearer the surface in the central parts of the sea than near the coasts or on the submarine slopes. Below this layer of minimum temperature, the temperature increases very slowly. At a depth of 100 fathoms the mean temperature is 47·7° F., the maximum being 48·2° and the minimum 46·2° F. At a depth of 200 fathoms the mean temperature is 48° F., the variations not exceeding 0·5° F. At still greater depths the temperature is nearly uniform at 48·2° F., with a maximum of 48·7° observed at 1100 to 1200 fathoms in the western basin of the sea.

We have prepared the accompanying diagram, showing the distribution of temperature in the waters of the Black Sea, from the observations made in the month of July 1890, and we give in the following table the observations upon which the diagram is based, the Stations being arranged in geographical order from west to east:—

[1] In 1887 we estimated the mean depth of the Black Sea and Sea of Azov at 412 fathoms (*Scott. Geogr. Mag.*, vol. iv. p. 32), but since then deeper soundings have been taken. The Russians have computed the mean depth of the Black Sea at 654 fathoms (1197 metres).

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SERIAL TEMPERATURE OBSERVATIONS taken by ss. *Tschernomoretz* in the Black Sea in the month of July 1890 (shown graphically in the accompanying diagram).

The longitudes are referred to St. Petersburg.

Depth in Fathoms.	No. 49, July 21, 1890 43° 17′ N., 1° 15′ W. 47 fathoms.	No. 50, July 21, 1890. 43° 32′ N., 0° 45′ W. 47 fathoms.	No. 47, July 20, 1890. 43° 51′ N., 0° 16′ E. 501 fathoms.	No. 46, July 20, 1890. 43° 53′ N., 0° 58′ E. 748 fathoms.	No. 45, July 20, 1890. 44° 15′ N., 1° 58′ E. 817 fathoms.	No. 44, July 16, 1890. 43° 57′ N., 3° 36′ E. 1177 fathoms.	No. 25, July 10, 1890. 43° 37′ N., 4° 19′ E. 1226 fathoms.	No. 26, July 10, 1890. 43° 14′ N., 5° 12′ E. 1219 fathoms.	No. 27, July 10, 1890. 43° 15′ N., 5° 59′ E. 1208 fathoms.	No. 28, July 11, 1890. 43° 10′ N., 7° 43′ E. 1178 fathoms.	No. 29, July 11, 1890. 43° 12′ N., 8° 32′ E. 1157 fathoms.	No. 30, July 11, 1890. 43° 12′ N., 9° 6′ E. 1009 fathoms.	No. 31, July 11, 1890. 43° 11′ N., 9° 40′ E. 650 fathoms.
	F.°	F.°	F.°	F.	F.°	F.°	F.°	F.°	F.°	F.°	F.°	F.°	F.°
0	75·7	78·6	76·8	76·1	73·9	73·2	71·4	72·3	73·6	74·3	76·1	76·3	75·9
2	...	...	...	...	...	...	...	...	...	...	...	76·1	...
4	...	...	...	...	...	...	...	...	...	...	...	75·9	...
5	72·3	71·6	71·8	73·6	72·1	71·8	71·4	72·0	73·6	73·6	75·9	64·4	65·7
6	...	...	...	...	...	...	...	...	...	...	...	57·2	...
7	...	...	...	..	...	...	...	...	...	..	...	...	58·6
8	...	...	..	...	...	...	...	...	...	...	...	51·1	...
10	63·7	63·3	65·3	65·7	60·1	60·1	64·6	48·9	53·4	57·2	53·6	49·3	51·3
12	...	...	...	...	...	...	59·0	47·5	51·4	...	48·7	48·2	50·0
15	53·4	51·1	49·8	57·2	48·7	49·6	50·7	46·0	48·4	51·4	46·6	46·8	47·5
17	...	...	...	...	...	...	...	...	...	...	...	...	46·4
20	47·3	47·8	...	48·9	46·6	47·7	48·6	44·6	46·2	48·4	45·3	45·3	45·1
25	46·0	45·1	44·6	45·3	45·3	45·9	45·9	44·1	45·7	45·7	44·2	44·4	44·2
30	45·3	44·1	45·3	44·8	44·6	44·8	45·0	44·4	46·2	44·4	...	44·1	44·1
35	44·6	44·4	46·2	44·4	44·6	45·0	44·8	...	46·6	44·2	45·1	...	43·9
40	44·6	45·3	46·6	43·9	45·7	...	46·2	...	...	...	...	...	43·7
45	45·7	46·4	46·6	44·1	46·0	...	...	...	...	...	...	...	...
50	...	...	46·8	44·8	46·4	46·0	46·9	46·6	46·9	46·0	46·4	46·2	44·4
60	...	...	...	46·4	47·3	...	47·3	46·9	...	...	...	...	...
65	...	...	...	46·4	47·3	...	...	...	...	...	...	...	...
70	...	...	47·8	46·8	47·5	...	...	...	...	...	...	...	...
75	...	...	...	...	...	...	...	...	...	...	...	47·7	...
80	...	...	...	46·9	...	...	...	...	...	...	...	...	...
95	...	...	...	...	...	...	...	...	48·2	...	...	...	...
100	...	...	47·8	47·7	47·7	47·7	47·7	47·7	48·2	48·0	48·2	48·2	47·7
175	...	...	...	...	...	...	48·0	...	...	...	...	...	...
200	...	...	48·0	48·0	48·0	47·8	48·2	48·0	48·2	48·2	48·2	48·2	48·2
300	...	...	...	...	...	...	...	48·2	...	...	48·2	...	...
400	...	...	...	...	...	...	...	..	...	...	...	48·2	...
600	...	...	...	48·2	...	...	...	...	...	...	...	...	...

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An examination of this table and diagram shows that during the summer season a stratum of colder water is sandwiched between warmer water above and below. This stratum is covered by a very thin layer of warm water, while the temperature of the underlying water increases very slowly down to the bottom. This peculiar thermal distribution is due to the influence of the under-current from the Bosphorus, which furnishes the deeper parts of the Black Sea with water of a higher salinity than that of the water cooled in winter at its surface.

The temperature of the surface-water was found to increase from 55·4° F. in May to 78·8° F. in August. Abrupt changes of temperature were sometimes observed near the coasts, but there was no evidence of any diurnal march of temperature in the open sea. On proceeding from the open sea towards the coasts the temperature was usually observed to rise, which seems to prove that in summer the re-heating of the water takes place principally in the shallow waters, and through the influence of the fresh water derived from the land.

Salinity.—The mean salinity of the surface-waters in the central parts of the sea was 1·83 per cent.; in August 1891 it was a little higher (1·85 per cent.) than in July 1890. Opposite the mouths of the rivers, notably of the Danube, the water is not so salt, and this is especially the case at the commencement of summer: in these positions the salinity increases rapidly from the surface to a depth of 15 fathoms, but in the open sea the salinity of this superficial layer varies very little. At a depth of 15 fathoms the maximum salinity (1·85 per cent.) was observed in the middle of the sea, and the minimum (1·78 per cent.) in the north-west part of the basin. At 25 fathoms the mean salinity was 1·83 per cent., but the maximum rises to 1·9 per cent. (in the middle of the sea), the minimum being 1·79 per cent. (in the north-west angle of the sea); thus the range is greater at 25 fathoms than at 15 fathoms. At 50 fathoms the mean of thirty-three observations taken in May and June 1891 was 1·97 per cent., the mean of thirty-nine observations taken in July 1890 was 2·03 per cent., and the mean of thirty-three observations taken in August 1891 was also 2·03 per cent.; the maximum was 2·08 per cent. in the centre of the sea, with a minimum of 1·85 per cent. near the coasts of the Crimea and Asia Minor, falling to 1·81 per cent. near Novorossiisk in the north-eastern part of the sea. At 100 fathoms the salinity in the central parts ranged from 2·14 to 2·16 per cent.; near the coasts and on the submarine slopes it was less, falling in some places to 2·06 per cent. At 200 fathoms the salinity varied from 2·19 to 2·21 per cent. in the deep parts of the sea, while at certain stations near the coasts, and especially opposite the Straits of Kertch, it was lower. At greater depths, from 400 to 1100 fathoms, the salinity varied only from 2·23 to 2·25 per cent, so that it may be said to be practically uniform at these depths.

The observations taken in the vicinity of the Bosphorus show that the salinity of the surface-water varied from 1·7 to 1·82 per cent., while at 25 fathoms the limits were 1·81 and 1·83 per cent., although the observations were made in different months and in different years. At the bottom in this locality, on the contrary, the salinity was very variable,

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depending evidently on the proximity of the wedge of salt water forming the submarine current from the Bosphorus, which appears to follow the submarine valleys leading from the bottom of the Bosphorus to the greater depths of the Black Sea. This is corroborated by the observations made at one station situated five miles from the Strait, and seven and a half miles from the place where the 100-fathoms line approaches nearest to the Bosphorus. Here during the half-hour occupied in taking the observations the ship drifted under the influence of wind and current from 29 fathoms into 45 fathoms of water; at 29 fathoms the salinity near the bottom was 2·04 per cent., at 35 fathoms 2·41 per cent., and at 38 fathoms 3·38 per cent.—the highest salinity recorded in the Black Sea, and almost identical with that found by Admiral Makaroff in the under-current near Bujuk-Dere. Probably the under-current, on leaving the Strait for the open sea, is divided into several branches, forming a kind of submarine delta, its salt waters being mixed very slowly with the surrounding fresh water. All the observations obtained in the summers of 1890 and 1891 indicated that the velocity and thickness of the submarine current were not very great; probably its mass and its velocity are more considerable in winter than in summer, especially after a spell of west winds, and that it maintains longer its velocity and level, losing itself gradually in the circumambient water, the temperature and salinity of which it raises.

Temperature and Salinity of the Sea of Marmara.—A brief summary of the results obtained by the Russian exploration of the Sea of Marmara in 1894 will not be out of place here, since no account of the Black Sea can be complete without reference to this "go-between" connecting the Black Sea and the Mediterranean. We have extracted the following particulars from the report published by the Imperial Russian Geographical Society of St. Petersburg in 1896.[1]

The bottom of the Sea of Marmara is more diversified than that of the Black Sea, presenting three hollows or basins attaining depths exceeding 600 fathoms, of which two are found in the western part of the sea, separated by a submarine elevation covered by 300 to 400 fathoms of water, the maximum depth in the one being 630 fathoms, and in the other 688 fathoms; while the third depression is situated in the eastern part of the sea, and exceeds 700 fathoms in depth, the maximum depth being 767 fathoms—the greatest depth observed in the sea. The mean depth of the Sea of Marmara has been calculated by the Russians at 158 fathoms (289 metres).

The mean temperature of the surface-waters during the period of observation (19th September to 20th October) was 67·1° F. (19·48° C.), while the salinity was found to increase in going from the Bosphorus to the Dardanelles. The freshest water is that bathing the vicinity of the Bosphorus: this must, without doubt, be attributed to the influence of the surface-current coming from the Black Sea, which after leaving the Bosphorus is split up, one branch flowing towards the northern coasts, the central branch being directed almost in a straight line from the Bosphorus

[1] See last item in footnote, p. 678.

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to Kalelimno Island, sending on the way a branch towards the Gulf of Ismid.

The vertical distribution of temperature and of salinity is extremely interesting. In general the temperature from the surface down to a depth of 6 fathoms remains almost uniform, but between 8 and 10 fathoms a rapid fall is observed equal to 0·9° to 1·1° F. per fathom; below this depth the lowering of the temperature becomes less and less pronounced down to 100 to 120 fathoms, whence down to the bottom the temperature remains uniform at 57·6° F. (14·2° C.). At the same time the salinity increases in an inverse manner: from the surface down to a depth of 6 fathoms the salinity increases slowly, about 0·02 per cent. per fathom, then it increases rapidly down to 14 fathoms, the mean increase being equal to about 0·14 per cent. per fathom; in deeper water the increase becomes less and less, so that between 25 and 100 fathoms the augmentation amounts to only 0·08 per cent. in all, and below 100 fathoms the salinity varies only from 3·83 to 3·85 per cent. There is thus, generally speaking, a perfect correspondence in the distribution of the thermic and saline layers; the zone of thermic fall is at the same time the zone of rapid augmentation in the salinity, and the layer of constant temperature coincides with the layer of nearly constant salinity. In fact, the waters of the Sea of Marmara may be looked upon as being stratified in a vertical direction, as regards temperature and salinity, into four zones:—

1. The zone from the surface to 6 fathoms with a mean salinity of 2·46 per cent., deviation ± 0·034 per cent., and a mean temperature of 67·3° F. (19·6° C.), deviation ± 0·05° F.

2. The zone of thermic fall and of rapid saline increase (from 6 to 14 fathoms), with a mean salinity of 3·12 per cent., deviation ± 0·352 per cent., and a mean temperature of 65° F. (18·3° C.), deviation ± 1·3° F.

3. The intermediate zone of slow decrease of temperature and slow increase of salinity (from 14 down to from 120 to 200 fathoms), with a mean salinity of 3·81 per cent. and a mean temperature of 59·5° F. (15·3° C.).

4. The zone of constant temperature (57·6° F.) and nearly uniform salinity (3·84 per cent.).

The thermic character of these zones, except that of constant temperature, depends generally on the annual changes in solar radiation, and may consequently vary in different seasons, but the modifications operating on the salinity of the water during the year, due to evaporation and the increase of fresh water received by the sea, are very insignificant and are only felt in the superficial layers.

Chemical Conditions.—There is a great difference between the chemical composition of the surface-waters and of those at the bottom of the Black Sea. According to Admiral Makaroff's observations the quantity of water introduced annually by the under-current from the Bosphorus is only $\frac{1}{2500}$ * of the volume of the Black Sea; so that, while the surface-waters are renewed each year, the water of the deeper layers can only be renewed once in 2500 years, or even longer. The consequence

* According to Andrussow $\frac{1}{1700}$.

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is that the upper layers, down to about 125 fathoms, are normal in character, containing the usual quantity of dissolved air—a quantity sufficient to sustain organic life, but the oxygen of the deeper, denser layers can only be renewed by diffusion and the submarine current coming from the Bosphorus, therefore much too slowly for the maintenance of organic life. In general, the sum-total of atmospheric gases diminishes with the depth; at the same time sulphuretted hydrogen is formed, being observed first at a depth of 100 fathoms (33 c.c. per litre), and augmenting gradually with increase of depth (222 c.c. per litre at 200 fathoms, 555 c.c. at 950 fathoms, and 655 c.c. at 1185 fathoms). Similarly sulphides appear and augment in quantity in ratio to the depth.

According to the researches of Zelinsky and Broussilovsky, the formation of hydro-sulphuric acid in the depths of the Black Sea is due to the activity of microbes. They have found several species, but only one has been studied (*Bacterium hydrosulfuricum ponticum*), which in anaërobic conditions sets free sulphuretted hydrogen not only from albuminous matters, but also directly from the sulphates and sulphides. A small quantity of cellulose and albumen, although not indispensable to the vital activity of these bacteria, contributes to their more rapid development. In consequence the writers are of opinion that the whole of the sulphuretted hydrogen in the Black Sea arises from the sulphates, but Andrussow thinks that part of it is due to organic matter. The superficial waters swarm with organisms (plankton), whose remains fall in a constant rain towards the bottom. In depths less than 100 fathoms these remains may be absorbed by other pelagic organisms, but beyond that depth they reach a domain devoid of life (except microbes). The organic matter reaching the bottom does not serve to aliment any benthonic organisms, as is usually the case in other seas and in the ocean, but accumulates and nourishes the bacteria, which form from the sulphur compounds sulphuretted hydrogen, and, seeing the deficiency of oxygen in the water, take from the sulphates what in turn produces sulphides and sulphuretted hydrogen:—

$$RSO_4 + 2C = 2CO_2 + RS\,;\quad RS + CO_2 + H_2O = H_2S + RCO_3.$$

The sulphuretted hydrogen thus formed is partially combined with the salts of iron (hence the abundance of sulphide of iron in the depths of the Black Sea), and only a part of it penetrates into the water and is thus distributed, its conservation being due in part to the intensity of the process, and especially to the poverty in oxygen of the deeper waters. In penetrating into the upper layers, and approaching the limit of vertical circulation, the sulphuretted hydrogen commences to oxidise and is gradually decomposed. Egounow supposes that this oxidation of sulphuretted hydrogen, observed very often in nature, is due also to sulpho-bacteria: if so, we may expect to find at a depth of 100 to 125 fathoms in the Black Sea an enormous layer of sulpho-bacteria.

Beside the formation of sulphide of iron, the hydro-sulphuric fermentation in the Black Sea leads to other chemical modifications in the water and in the deposits, viz. a relative diminution of the sulphates, and an augmentation of the quantity of carbonates, in the deeper waters, which

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is corroborated by the fact of the deposition of a powdery precipitation of carbonate of lime in the deep deposits.

Fauna.—The marine fauna of the Black Sea properly so-called, *i.e.* the fauna of the denser waters of the inhabited regions of the sea, consists of forms derived from the Mediterranean through the Sea of Marmara and the Bosphorus. Only those eurybiotic forms capable of supporting life in water with a much lower salinity could penetrate from the Mediterranean into the Black Sea; hence the fauna of the Black Sea is not so rich as that of the Mediterranean: several classes of organisms (*e.g.* Corals, Siphonophoræ, Echinoids, Pteropods, Cephalopods) are entirely absent, while others are poorly represented (only a single Ctenophore, one little Holothurian, and two very small Ophiurids are known from the Black Sea). The thermic conditions of the Black Sea (its more rigorous temperature, the presence at a moderate depth of a layer of cold water) are also obstacles to the penetration of organisms, permitting the establishment of only eurythermic and oligothermic forms. Hence the preservation of relics of the glacial epoch, which were able to enter the Black Sea by way of the Mediterranean; with the arrival of a warmer climate they have disappeared from, or become rare in, the Mediterranean, but, finding in the Black Sea more favourable conditions of life, some of them have there developed wonderfully. Such an example is *Modiola phaseolina*, a common shell on the shores of England, found also in the Mediterranean; but, while in the Sea of Marmara isolated examples are met with, masked by the mass of other shells, in the Black Sea it attains a very rich development, giving a special *Modiola* facies to the fauna all round the sea in depths of 35 to 100 fathoms. Over all this extent the bottom is muddy, and covered, besides an immense quantity of *M. phaseolina*, by numerous shells of other species (*Cardium fasciatum, Mactra triangula, Scrobicularia alba, Cerithium pusillum, Trophon breviatum*), peopled by simple Ascidians, little Ophiurids, a small *Synapta*, Annelids with muddy tubes, *Cerianthus vestitus*, etc.

Below this zone of *Modiola*-mud, which is very constant because of the constancy in the physico-geographical conditions, comes the hydro-sulphuric region—the domain of hydro-sulphuric bacteria—separated perhaps from the *Modiola*-zone by a zone of sulpho-bacteria. In shallower water, between the shore and the 25-fathoms line, there is a greater differentiation of the facies, corresponding to the different physical conditions. Unfortunately the observations are too few in number to indicate the exact character of the subdivisions and the facies of the littoral and shallow-water fauna of the Black Sea, which is influenced by the oscillations in the salinity of the water, as well as by the depth and character of the bottom. Thus the littoral fauna is richer on the coasts of Caucasia and the Crimea, where the salinity is higher, than on the coasts near Odessa and in the Sea of Azov, where the salinity is lower. This is well shown by the following table prepared by Ostroumow, in which the number of species of Molluscs belonging to the different basins is expressed in percentages, the number of species known from the Archipelago being taken as 100 :—

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	100 per cent.
The Archipelago,	
The Sea of Marmara, at the entrance into the Bosphorus,	58·5 „
The upper Bosphorus,	36·8 „
The Black Sea,	22·2 „
The lower part of the Sea of Azov,	6·3 „
The middle part of the Sea of Azov,	3·6 „

At the mouths of the rivers, which in Southern Russia are known by the name of "limans," the elements derived from the Mediterranean become less numerous, giving place to forms identical with those of the Caspian Sea or to forms peculiar to the "limans." These forms may be regarded as relics of the brackish-water fauna of the Black Sea of the pliocene period. As examples of forms encountered also in the Caspian Sea may be cited:—*Archæobdella*, *Clessinia variabilis* (from the "liman" of the Bug), *Neritina lithurata* (from the Sea of Azov), *Gmelina*, *Gammarus mæoticus*, *Pseudocuma pectinata*, *Paramysis baeri*, *Mesomysis Kowalevskyi* and *intermedia*, *Lymnomysis benedeni* and *brandti*, and species of *Gobius*, *Clupea*, and *Accipenser*. There are other species which, though not identical, are closely allied to Caspian Sea forms, such as *Dreissensia bugensis* (allied to *D. rostriformis* and *grimmi*); *Cardium ponticum* (allied to *C. caspium*); *Cardium coloratum* (allied to *Monodacna edentula*); *Amphicteis antiqua* (allied to *A. Kowalevskii*); *Bythotrephes azovicus* (allied to *B. socialis*). Other species again are peculiar to the Sea of Azov (like *Corniger mæoticus*, *Mæotias inaspectata*, *Thaumantias mæotica*, and *Asperina improvisa*), or to the "limans" (like *Euxinomysis mecznikovi*).

Evolution of the Black Sea.—Andrussow draws attention to the fact that, in the deep mud of the Black Sea (from 100 down to about 600 fathoms), which at the present time is quite devoid of life (except perhaps microbes), they found the subfossil remains of brackish-water Mollusca, *e.g. Dreissensia polymorpha*, *D. rostriformis*, var. *distincta*, *D. tchaudæ*, var. *pontica*, *D. crassa*, *Monodacna pontica*, *Didacna* sp., *Micromelania caspia*, *Clessinia* sp., *Neritina* sp.

It is impossible to suppose that these species are to-day living in these depths. The high salinity of the water (2·1 to 2·2 per cent.) precludes this idea, for the maximum salinity of the water at which some of the forms are now living in the Caspian Sea does not exceed 1·5 per cent. The surface-water of the Black Sea has a mean salinity of 1·81 per cent., and in the southern part of the Sea of Azov it falls to about half of this, but nevertheless even here neither living *Dreissensiæ* nor brackish-water Cardidæ are found. It is further impossible to suppose that these shells have been transported by currents or waves; some of the species no longer exist in the region of the Black Sea, and if transported by waves these mostly fragile shells could scarcely have been found in an uninjured condition, but only as rounded fragments, and they would have been accompanied by the shells of species living on the continental platform in depths under 100 fathoms, which have never been observed. We can therefore only conclude that these mussels are relics of an epoch, not far distant, when the Black Sea represented a colossal brackish-water basin. This state of things must have continued up to a com-

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paratively recent date, because these shells belong to living species, and the layer of mud is not sufficiently thick to prevent the shells being brought up by the dredge. The physical relations of this brackish-water basin were similar to those of the Caspian Sea, *i.e.* its water had a low salinity, not over 1·5 per cent., probably much less; the climatic relations were, however, more severe, at least towards the end of its existence, which was contemporaneous with the glacial period. The thermic relations were in general similar to those of the Caspian, *i.e.* the water had a perfect vertical circulation as a result of the small differences in the specific gravity at the surface and in the deeper water, but on account of the severe climate the bottom temperature must have been lower than that of the Caspian; the vertical circulation provided the deeper waters with atmospheric gases, so that organic life was possible at all depths.

Andrussow believes that the Black Sea had not ceased to be a closed sea at the opening of the post-tertiary period, and that the commencement of this state of things coincided with the pontic epoch (in the restricted sense of the term). There are reasons for believing that the formation of the deep depression of the Black Sea corresponds with a more ancient epoch than has been supposed. The existence near Bourgas of oligocene deposits like those of Ekatherinoslaw, the character of the development of the Tchokrak strata and those at Spaniodon, the presence of the sarmatic near Varna and Bourgas, on the borders of the Sea of Marmara, near Sinope and in Transcaucasia, the discovery of the Tchaouda layers, with *Didacna crassa* and *Dreissensia tchaudæ*, at Cape Tchaouda in the Kertch peninsula and near Gallipoli—all these facts show that the actual basin of the Pontus Euxinus had formerly been occupied by water. That it was as deep in the miocene period as it is now is another question. Down to the end of the sarmatic period, and perhaps in the meotic, this basin communicated, though indirectly, with the ocean, but in the pontic epoch it became isolated. The consecutive changes following the pontic epoch are very difficult to follow, the basin having probably occupied an extent less than that of to-day, and having left only feeble traces of its existence. Thus, at the epoch posterior to the pontic come the strata of Kouïalnik near Odessa, then the Tchaouda layers (upper pliocene), and finally, at the beginning of the post-tertiary period, the strata with Caspian fauna of southern Bessarabia and of the Kertch peninsula. After the deposition of the last-mentioned, topographical changes took place which led to the passage of the waters of the Mediterranean into the Pontus Euxinus. The union of this brackish-water basin with the Mediterranean brought with it a perfect revolution in the physical, chemical, and biological relations.

Neumayr[1] has shown that this union was brought about by the subsidence of a large continent which occupied the position of the present Ægean Sea, joining Asia Minor to the Balkan peninsula. This Ægæa

[1] "Zur Geschichte des östlichen Mittelmeerbecken, Erdgeschichte," Bd. ii., Berlin, 1882; see also Oppenheim, "Beiträge zur Kenntniss des Neogen im Griechenland," *Zeitschr. d. deutsch. geol. Ges.*, 1891. p. 482.

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gradually sank under the surface of the sea, and caused a gradual approach of the Mediterranean towards the Black Sea.[1] Andrussow believes that the formation of the present straits of the Bosphorus and Dardanelles was not a geotectonic process, but that they were old river-beds, through which the waters from the Ægæan continent flowed into a sea occupying the site of the present Sea of Marmara, and from this through the Bosphorus into the Black Sea, the surface of which has several times been below its present level.

The presence of the sea-pig (*Phocæna communis*) in the Black Sea can only be explained by supposing that it communicated with the Mediterranean while certain northern species remained in the Mediterranean, *i.e.* during the glacial period. The introduction of the dense Mediterranean water into the Black Sea gave rise to the upper and under currents of the Bosphorus and Dardanelles, as we see them to-day, due to the great difference between the densities of the two bodies of water. Had this difference in the density become equalised the currents would long ago have ceased, but since the climatic conditions in the region of the Black Sea, as compared with the region of the Mediterranean, are very unlike, the Black Sea receiving a great supply of fresh water while the evaporation is much less than in the Mediterranean, equilibrium is never reached, and the currents continue. The relative uniformity in the specific gravity of the water in the original basin was gradually destroyed, a thicker and thicker layer of salt heavy water was formed in the greater depths, until finally there is at the present time a stratum of water about 1000 fathoms in thickness at the bottom of the Black Sea having a salinity of 2·1 to 2·5 per cent., while the upper 100 fathoms has a salinity, decreasing rapidly towards the surface, of 2 to 1·7 per cent., and even less. The formation of the dense under layer has had an important result: the limitation of the vertical circulation to the thin upper layer, and the stagnation of the deeper portion. This doubtless accounts for the remarkable distribution of temperature observed in the Black Sea, viz. the presence of a cold stratum of water between two warmer strata. The limited circulation led to the defective ventilation of the depths, for the atmospheric gases could no longer reach the greater depths through descending currents but only through slow diffusion, hence the conditions for life became unfavourable. The deep-sea inhabitants of the Black Sea would thus be killed out, while some of the shallow-water forms might retire to the river mouths; at the same time only a very small proportion of Mediterranean forms would be able to penetrate into the Black Sea, and only such of these as could withstand great changes in temperature and salinity would be able to survive. The neighbourhood of the Bosphorus was the first station (and is so now) for this immigration; the salinity at the bottom is here much higher, consequently a greater development of animal life is found than in the remainder of the Black Sea. Some forms would be unable to migrate

[1] Stefani, on the contrary, believes that the Ægean Sea existed already in the pontic epoch, and that it communicated with the Pontus Euxinus; the lower salinity of the latter would be maintained owing to the climatic and topographic conditions (*Ann. Soc. geol. Belge.*, 1891).

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further, while others would be distributed round about the Black Sea, actively along the coasts, and passively with the currents (larvæ and plankton). At the same time a movement towards the deep water would commence, but the muddy character of the bottom, the shallowness of the Bosphorus, and the rigorous climatic conditions, explain the comparative poverty of the mud-region between 30 and 100 fathoms, while the immigration of animals into depths exceeding 100 fathoms was impossible, for deep-sea organisms could not pass through the Bosphorus.

Deposits.—The deposits now being laid down on the floor of the Black Sea may all be called Blue Muds, but in the shallower water between 30 and 100 fathoms there is an admixture of mussel shells (principally *Modiola phaseolina*), and at one place opposite the delta of the Danube the bottom appears to be covered by large *Mytilus* shells overgrown by *Lithothamnion*. Only one sample, from 58 fathoms, opposite the Bosphorus, contains what can be called sand or gravel, and here it is mixed with a very large proportion of broken shells.

Manganese was not observed in any of the samples from deep water, and even in shallow water it occurred in abundance only in one deposit-sample from 53 fathoms, in the form of concretions of iron and manganese around the small shells of *Modiola*; these concretions take the form of the separated valves, being oblong, concave on the one side and convex on the other. Sometimes there is a large proportion of manganese in the concretions, but in other cases the characteristic black streak when treated with concentrated hydrochloric acid is not observed, and the proportion of peroxide of iron is greater. At another station, from a depth of 58 fathoms, the edges of the broken shells were covered by a cushion of oxide of iron, containing little or no manganese. At other places, in shallow water (25 to 67 fathoms), some of the shells and fragments are discoloured, apparently by manganese, but it is present only in small quantity.

Sulphide of iron is widely distributed in the deeper samples. It is observed in the deposit-samples from 220 fathoms down to the greatest depths. Usually it is in the form of minute spherules disseminated through the mud, or impregnated in the Diatoms, etc., but sometimes it is seen as larger spherules and irregular particles, and in one sample from 387 fathoms it was found in great abundance in the form of elongated irregular little nails, looking at first sight like small twigs, some of them being a centimetre in length.

Chemical analysis showed that these pyrites concretions consisted substantially of sulphate of iron ($FeSO_4$), with traces of sulphur, calcium, carbonic acid, and insoluble matter. The total iron calculated as sulphide (FeS) is equal to 44 per cent., and as sulphate ($FeSO_4$) 76 per cent. Doubtless before oxidation, *i.e.* before exposure to the air, this material consisted of ferrous sulphide (FeS) with traces of lime, magnesia, and insoluble clayey matter. It is very peculiar to find such a deposit so practically pure as this, and its formation would have been impossible unless the materials were protected from oxidation by being surrounded by water containing a large amount of sulphuretted hydrogen or

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carbonic acid. Its deposition cannot be explained otherwise than by supposing that the iron was present in a soluble condition in the water, and that it gave rise to a precipitate of nearly pure ferrous sulphide. In its present condition the material has a strongly acid reaction from formation of acid sulphate of iron, causing indeed slight effervescence when treated with water, owing to the decomposition of the carbonates present.

This Station in 387 fathoms, situated in the south-eastern portion of the Black Sea basin, to the east of Sinope and north of Samsoun, is one of the most peculiar and interesting of the whole series, and may be referred to in some detail. The sounding-tube here brought up only a light coloured blue-grey mud, but the dredge had evidently dipped deep into the deposit, and brought up, as well as the light blue-grey mud, a greenish mud, and a stratified mud. The upper surface of the deposit at the bottom is evidently formed of the light blue-grey mud brought up by the sounding-tube, but what the thickness of this layer may be is doubtful; this mud contains 36 per cent. of carbonate of lime, which is mostly in an amorphous condition, though one or two small Mollusc and Ostracode shells were observed; the nail-like concretions of iron pyrites above mentioned were observed only in this layer, along with smaller particles of various shapes and sizes, and a few of the usual mineral particles (quartz, felspar, mica, hornblende, glassy particles), one or two Sponge spicules, and clayey matter. Beneath this upper layer was apparently the green-grey mud, which is tenaceous and clayey, and tends to separate into layers; it contains 16 per cent. of carbonate of lime, mostly amorphous, but with a few small Mollusc shells and skeletal fragments of small fishes, along with small mineral particles, a few Sponge spicules, and clayey matter. Beneath the green mud came apparently the stratified mud, composed of layers of a blue-grey tenaceous, clayey mud, separated by thin layers or mere lines of a white, chalky, powdery substance, along which the material splits up with ease; this mud contains 18 per cent. of carbonate of lime (which in the blue layers is amorphous, while the white layers and white spots are composed of crystalline carbonate of lime in the form of minute elongated grains, about 0·01 mm. in maximum diameter), with many very small ordinary mineral particles, a few Sponge spicules, and clayey matter. A sample of dark blue-grey mud was received from Professor Andrussow, labelled as from this Station, the position of which at the bottom is doubtful, but it may possibly have formed the lowermost stratum of all, since it contains a much larger proportion of mineral particles, and less carbonate of lime (11 per cent., in an amorphous condition) than any of the others.

The percentage of carbonate of lime found by analysis in the samples from depths less than 100 fathoms varies from 11 to 37; this result depends largely upon the proportion of shell-fragments present in the small quantity of material used for the analysis. In depths over 100 fathoms the percentage of calcium carbonate also varies to a great extent, but here the carbonate of lime is mostly in an amorphous condition, though there may be a few fragments of Mollusc shells, or Ostra-

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coda, or Foraminifera, but in one instance (already referred to) the carbonate of lime appeared to be in a crystalline condition.

The percentage of carbonate of lime was determined in nearly all the samples received by us, and we have laid down the results on the accompanying map with the view of showing the distribution, which has apparently no definite relation to the depth of water. The only general remark applicable to this distribution is that the higher percentages (over 40) occur in deep water (748 to 1184 fathoms), and yet the deposits from the deepest part of the sea (over 1200 fathoms) contain only a small percentage (13 to 18). The highest percentage (65, which is much higher than in any other sample) was observed at 1184 fathoms, about eighty miles from the Bosphorus, and other two percentages exceeding 40 occur farther to the north and east, in the course, according to some authorities, of the inflowing current from the Bosphorus, but a percentage of 48 is recorded in the deposit from 1050 fathoms in the south-eastern part of the sea, removed from the influence of the inflowing Bosphorus current. The lowest percentage (9·74) is recorded in the deposit from 220 fathoms opposite Batoum, in the extreme eastern part of the sea.

We give here a few general remarks on the deposits of the Black Sea, received from Professor Andrussow in manuscript, followed by detailed descriptions of the *Tschernomoretz* samples, and a few notes on the contents of the dredges and tow-nets:—

Sands.—Coarse sediments (sands and gravels) have a very limited distribution in the Black Sea. More or less clean sand is confined within very shallow depths; thus the deeper boundary of the area of distribution of the sand is found at Laspi in 10 fathoms, at Kikineiz in 11 fathoms, at Gutsuf in 13 fathoms, at Aluschta in 10 fathoms, at Sudak in 11 fathoms, at Koktebel in 8 fathoms, at Cape Kodor in 18 fathoms. In the north-western shallow part of the Black Sea, sand is more widely distributed, the sand-zone reaching at least a depth of 29 or 30 fathoms. The greatest depth to which sand reaches in the Black Sea is found opposite the Bosphorus in a depth of 58 fathoms. The dredge here brought up a muddy sand, which contained little rounded grains of quartz and of volcanic rocks, apparently transported by the Bosphorus under-current.

Mussel beds.—Banks of mussels (*Ostrea*, *Pecten*, *Mytilus*) are found principally in the sand-zone. The *Tschernomoretz* came across two such banks: at Station 54 the trawl brought up only shells of *Mytilus edulis*, overgrown with Monaxonid Sponges; at Station 55 the trawl came up full of *Mytilus* shells, overgrown by *Lithothamnion*, on which *Phyllophora* was observed.

Mud deposits.—The remainder of the floor of the Black Sea is covered by mud, which varies in character according to depth and position. I was able to distinguish the following kinds:—

(*a*) Black Mud of the north-west part of the sea. This mud covers the bottom of those shallow depressions lying south-east of Odessa; its greatest depth is 17 fathoms. The mud is of a black colour, but on exposure to the air becomes slowly grey. The Molluscan fauna is very

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different from that of the Modiola Mud, for mussels are rather rare, the principal species being *Mytilus edulis*, while the presence of *Cardium exiguum* is also characteristic. The existence of arenaceous Foraminifera is very interesting. Diatoms are numerous, the most abundant being *Melosira, Navicula, Nitzschia, Pleurosigma*; other pelagic forms are rare.

(*b*) Modiola Mud. This mud was found by the *Tschernomoretz* in depths of 30 to about 100 fathoms, forming a girdle around the whole sea. Sometimes it contains a fair quantity of thin, transparent Molluscs (*Modiola phaseolina, Cardium fasciatum, Syndesmia alba, S. nitida, Mactra subtruncata, Trophon breviatum, Cerithium pusillum*). The colour is usually blue (when fresh); often there is a thin surface-layer of a reddish colour, which is due to the oxidation of the iron protoxide compounds. Sometimes there are manganese-iron concretions. At Stations 2 and 3 these concretions are formed in the shells of *Modiola phaseolina*; at Station 15 the iron-hydroxide precipitations form incrustations on the edges of the broken *Mytilus* shells. The Modiola mud is moderately tenaceous, contains very little sand, and is very poor in the remains of microscopic organisms. There are Ostracodes, and rarely little Foraminifera (*Rosalina, Lagena*, and *Entosolenia*); Diatoms are extremely rare; Sponge spicules are moderately abundant.

(*c*) Black Mud from medium depths. A sticky, tenaceous, light grey mud, with black upper surface, is found near the shore in depths of 200 to over 700 fathoms, that is on the flanks of the deep basin of the Black Sea. The black colour of the surface is due to the large quantity of sulphide of iron, which in the air is easily oxidised, and therefore the mud becomes grey immediately on exposure to the air. When the freshly collected mud is treated with cold hydrochloric acid, one observes the abundant development of sulphuretted hydrogen, the mud at the same time turning a bluish grey. Under the microscope the black pigment (sulphide of iron) appears in the form of little black globules, or impregnated in the quartz grains. Especially interesting is the entrance of the sulphide of iron into the interior of the Diatoms. It is difficult to find an example of a Diatom without one or more little black globules, and often the Diatoms are quite full of them. The presence of sulphide of iron in *Rhizosolenia* gives it a singular appearance, resembling under low powers a string of pearls. There is always a certain quantity of fine quartz sand. Of microscopic organic remains may be mentioned Diatoms, *Dictyocha*, and embryonal shells of bivalves. The shells of growing, living Molluscs are absent, there being only sub-fossil shells of brackish water forms which are no longer found living in the Black Sea, like *Dreissensia rostriformis, Cardium ponticum*, and *Micromelania caspia*. At one station from a depth of 87 to 105 fathoms, the dredge brought up a grey mud, which contained a mixture of brackish water mussels with the usual forms of the Modiola Mud.

(*d*) Blue Mud. At Station 39, from a depth of 387 fathoms, the sounding-tube brought up, instead of the usual grey mud with black surface-layer, a blue-grey mud. The same mud came up in the dredge, but was there mixed with two other kinds of mud (green mud and stratified mud). This mud contained many little pyrites concretions

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(FeS_2), in the form of long drawn-out knobby nails, with small twigs of plants, and bones of small fishes (pelagic *Singnathus*?).

(*e*) Green Mud. This mud has a greater consistency than the Blue Mud brought up by the sounding-tube, which seems to indicate that the green mud underlies the blue mud.

(*f*) Stratified Mud. The dredge brought up at the same Station a very remarkable kind of mud. In the fresh condition the pieces of this mud look like a colloidal substance, being to a certain extent plastic and elastic. Even in the wet state the mud was seen to be finely stratified, and this is more evident as the mud becomes dry, for it splits up into thin layers. Some layers are greenish; others quite white. The green substance is clayey, and effervesces very little (if at all) on treatment with hydrochloric acid, but the white substance is completely dissolved with strong effervescence. Under the microscope this powdery, white substance is seen to be composed of very small, elongated, rounded, wheat-grain-like, little crystals, which give strong interference-colours in polarised light; one observes also ×-formed twin-crystals. In the greenish, clayey substance isolated embryonal bivalve shells are imbedded.

(*g*) Dark blue Mud, and light blue Mud with white spherules, in the great depths of the Black Sea. The flat, deep bottom of the Black Sea, beyond 700 fathoms, is covered by two kinds of mud, which pass the one into the other by various transitional kinds. The light blue mud differs from the dark blue mud in that it contains a greater or less abundance of light coloured little lumps or spherules, which remain behind on washing the mud in a sieve. Crushed under the microscope, they are seen to be composed of a fine-grained mass; when dry the spherules become white and pulverulent, and dissolve with effervescence in acid. As regards organic remains, it may be remarked that Diatoms are here less numerous, and they belong mostly to true pelagic species; there are also more embryonal shells of bivalves and little fish-bones.

Descriptions of the Deposit-Samples collected by ss. "Tschernomoretz."[1]

Station 2, lat. 45° 4′ N., long. 2° 14′ E., 53 fathoms.

Light blue-grey Mud ("**Modiola Mud**"), containing many shells of *Modiola*, some of which are more or less impregnated and coated with oxide of iron and manganese; the mud is coherent and clayey.

Calcium Carbonate (33·5%), amorphous calcareous matter, with many Mollusc shells and fragments of Ostracodes, Foraminifera (*Rotalia*).

Residue (66·5%), brownish grey.

Minerals [10%], m.di. 0·1 mm., angular, spherules and irregular particles of sulphide of iron, quartz, felspar, mica, hornblende, glassy particles, glauconite (?) There is only 2 or 3% of minerals proper exceeding 0·05 mm. in diameter, but the iron sulphide is abundant.

Siliceous Organisms [1%], Sponge spicules.

[1] The longitudes are referred to St. Petersburg.

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Fine Washings [55·5%], amorphous clayey matter, with many minute spherules of iron sulphide, and other small mineral particles.

The dredge brought up at this Station: small Monaxonid Sponge, *Amphiura florifera*, *Cynthia*, *Modiola phaseolina*, *Scrobicularia alba*, *Cardium fasciatum*, *Trophon breviatum*, *Rissoa*, and *Cerithiolum*.

STATION 3, lat. 44° 39′ N., long 2° 59′ E., 50 fathoms.

Modiola Mud, blue-grey when fresh, with a thin red surface-layer, grey when dry; contains *Modiola phaseolina*, *Bulla truncata*, *Cerithiolum pusillum*, Annelid tubes composed of mud and slime, and concretions of iron and manganese.

STATION 4, lat. 44° 11′ N., long. 2° 34′ E., 993 fathoms.

The sounding-tube brought up a very little blue-grey mud. The tow-nets at the surface gave *Cydippe*, Copepods, *Sagitta*, *Noctiluca*, *Coscinodiscus*, and unicellular Algæ.

STATION 5, lat. 43° 1′ N., long. 2° 0′ E., 1144 fathoms.

The sounding-tube brought up only a small quantity of flocculent dark-grey mud with white spherules; under the microscope were seen *Dictyocha*, *Actiniscus Coscinodiscus*, mandibles of *Sagitta*, and vegetable matter.

STATION 8, lat. 41° 41′ N., long. 0° 1′ W., 984 fathoms.

Mayer's water-bottle brought up a little blue-grey mud. The tow-net at the surface gave: *Noctiluca*, unicellular Algæ, and embryonal Gasteropods.

STATION 10, lat. 41° 25′ N., long. 0° 20′ W., 445 fathoms.

Stiff grey mud with black upper surface. The black colour is due to an excess of black spherules of sulphide of iron, which occur either isolated or in the interior of the Diatoms: *Rhizosolenia*, *Navicula interrupta* (?).

STATION 11, lat. 41° 25′ N., long. 0° 41′ W., 363 fathoms.

Blue-grey Mud, clayey, very coherent.

CALCIUM CARBONATE (12·95%), mostly amorphous, but a few fragments of Bivalve and Ostracode shells were observed.

RESIDUE (87·05%), darker grey.

Minerals [3%], m.di. 0·1 mm., angular, quartz, mica, felspar, hornblende, glauconite (?), glassy particles, spherules and irregular fragments of pyrites.

Siliceous Organisms [1%], Diatoms, Sponge spicules.

Fine Washings [83·05%], amorphous clayey matter impregnated with sulphide of iron, and with many small mineral particles.

The trawl brought up a large mass of mud, which appeared to be grey, but was in many parts quite black; on being exposed the black parts immediately became grey. In the washings were sub-fossil shells of *Dreissensia rostriformis* and *Micromelania caspia*.

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STATION 12, lat. 41° 21′ N., long. 0° 53′ W., 50 fathoms.

Modiola Mud, with *Polystomella*, *Entosolenia*, *Textularia*, shells of *Codonella*, smooth Ostracodes, *Coscinodiscus*, *Navicula*, *Striatella unipunctata*.

STATION 13, lat. 41° 26′ N., long. 1° 8′ W., 60 fathoms.

Modiola Mud, with *Amphiura*, *Cynthia*, and Molluscs (*Cryptodon*, *Cyclonassa*, *Trophon*, *Bulla*, *Cardium*).

STATION 14, lat. 41° 23′ N., long. 1° 7′ W., 58 fathoms.

Grey Muddy Sand, with rolled pebbles.

The dredge brought up some interesting things, especially: Foraminifera (*Haplophragmium*, *Textularia*, *Triloculina*, *Rotalina*, *Truncatulina*, *Polystomella*), *Amphiura*, *Cucumaria* (*Ocnus*) *orientalis*, Echini spines, *Salicornaria*, many Sponges, *Virgularia*, Ascidians, Polychaeta, etc. Besides the species of Molluscs characteristic of the Modiola Mud, were several forms which are unknown or rare in the Black Sea, e.g., *Nucula nucleus*, *Turritella*, etc. There were also sub-fossil brackish water species: *Dreissensia* and fragments of large *Limnocardium*. The relative richness of the fauna at this Station may be explained by the fact that it lies in the bed of the Bosphorus under-current, which on entering the Black Sea moves along for a long time independently, and is only gradually mixed with the waters of the Black Sea. At this Station the specific gravity on the bottom was 1·0204, while at the surface the usual specific gravity of the Black Sea (1·01293) was observed. The position also explains the presence of the rolled pebbles and gravel, which have been transported by this under-current, for at this depth in other parts of the Black Sea fine mud is usually observed.

STATION 15, lat. 41° 21′ N., long. 0° 26′ W., 58 fathoms.

Modiola Mud. The edges of the broken Mollusc shells are covered by a cushion of oxide of iron. In the stomach of a *Cynthia* from the dredge were many Diatoms: *Striatella unipunctata* (?), *Cocconeis* sp. (?), *Nitzschia* (*Tryblionella*) *punctata* (?), *Achnanthes*, *Epithemia*, *Synedra delicatissima*, *Campylodiscus*, *Rhizosolenia*, *Navicula lyra*, *N. interrupta*, *N. elliptica*, *Grammatophora marina*, as well as silico-flagellata (*Dictyocha fibula*, *D. speculum*, and *Actiniscus*).

STATION 16, lat. 41° 22′ N., long. 0° 5′ E., 60 fathoms.

Modiola Mud, reddish when dry, containing a good deal of sand. Besides the usual mussels (*Modiola phaseolina*, *Scrobicularia alba*, *Cardium*), microscopic examination showed in this mud also Foraminifera (*Rosalina*, *Trincatulina*, *Textularia*, and *Entosolenia*), spicules of *Synapta*, and Diatoms (*Coscinodiscus*, *Melosira*).

STATION 17, lat. 41° 55′ N., long. 1° 20′ E., 1142 fathoms.

Fine Mud, dark blue when wet and freshly collected, becoming rapidly grey in contact with the air; grey when dry. Contains much sulphide of iron in the form of little spherules or infiltrated into the cracks of the larger mineral particles. Of microscopic remains of organisms were observed: embryonal shells of bivalves, and arenaceous Foraminifera, Diatoms: little *Coscinodiscus*, *Melosira*, *Epithemia*, and *Hyalodiscus* (?).

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STATION 18, lat. 41° 55′ N., long. 2° 0′ E., 715 fathoms.

Blue-grey Mud, with white spots, very coherent, clayey.

CALCIUM CARBONATE (18·25%), mostly amorphous, but one or two small Mollusc shells and fragments were observed.

RESIDUE (81·75%), dark grey.

Minerals [2%], m.di. 0·1 mm., angular, quartz, felspar, mica, hornblende, olivine, glauconite (?), coloured particles, glassy particles, spherules of sulphide of iron.

Siliceous Organisms [1%], Diatoms, Sponge spicules.

Fine Washings [78·75%], amorphous clayey matter, impregnated with sulphide of iron, and with many small mineral particles.

The sounding-tube brought up a light blue mud, while in the water-bottle was a blackish mud mixed with water. Sulphide of iron was specially abundant in the interior of the Diatoms as well as isolated. Of organic remains were observed: embryonal shells of Bivalves, one embryonal shell of a Gasteropod, *Actiniscus* (many), Diatoms: *Coscinodiscus, Melosira, Rhizosolenia, Hemiaulus hauckii, Navicula, Pleurosigma, Synedra gracilis* (?), *Grammatophora*, spicules of Monaxonid Sponges.

STATION 19, lat. 42° 5′ N., long. 2° 8′ E., 1182 fathoms.

Of organic remains were observed: a tiny Foraminifera shell, *Dictyocha, Actiniscus*, Diatoms: *Coscinodiscus* several species, *Cocconeis scutellum* (?), *Rhizosolenia, Grammatophora macilenta* (?), *Melosira, Synedra gracilis, Navicula abrupta* (?), *Pyxilla, Striatella unipunctata, Cymbella*, and many Sponge spicules.

STATION 20, lat. 43° 10′ N., long. 3° 47′ E., 1219 fathoms.

Light blue mud, with very many spherules of sulphide of iron. Organic remains observed: *Melosira, Navicula lyra, N. elliptica, Coscinodiscus, Actinocyclus, Grammatophora marina, Thalassiothrix, Epithemia, Synedra undulata* (?), *Striatella unipunctata, Rhizosolenia, Chætoceras, Cocconeis scutellum, Actinoptychus undulatus, Campylodiscus, Grammatophora serpentina, Navicula interrupta* (?), *Diatoma* (*Odonellum*) sp. (?), *Surirella fastuosa* (?), *Pleurosigma, Stephanodiscus astrea*; Foraminifera (*Lagena, Entosolenia*); *Actiniscus, Dictyocha speculum, D. fibula*; Sponge spicules.

STATION 21, lat. 44° 41′ N., long. 4° 57′ E., near Meganon, 240 fathoms.

Light blue-grey Mud, very coherent, clayey, with black lines and spots due to sulphide of iron.

CALCIUM CARBONATE (16·75%), mostly amorphous; one or two small Bivalve shells observed.

RESIDUE (83·25%), darker grey.

Minerals [10%], m.di. 0·1 mm., angular, pyrites, quartz, felspar, mica, glauconite (?), glassy particles. The minerals proper make up probably only 2 or 3%, but of pyrites alone there is probably 5 to 10%.

Siliceous Organisms [1%], Sponge spicules, Diatoms (*Epithemia* and *Navicula*) filled with sulphide of iron.

Fine Washings [72·25%], amorphous clayey matter, impregnated with sulphide of iron, in the form of minute spherules (0·01 to 0·02 mm. in diameter), and larger irregular particles, and small particles of other minerals.

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STATION 23, lat. 44 28′ N., long. 4° 3′ E., opposite Nikita, 344 fathoms.

Grey Mud, with black upper surface, containing many quartz grains. Organic remains observed : *Cocconeis scutellum, Grammatophora, Actinoptychus undulatus* (?), *Rhizosolenia, Campylodiscus, Pleurosigma, Biddulphia pulchella* (?), *B. tuomeyi* (?), *B. bailyi, Surirella fastuosa* (?), *Navicula interrupta, N. elliptica, Synedra undulata, S. fulgens* (?), *Coscinodiscus* several species, *Melosira, Striatella unipunctata, Surirella, Amphora, Amphipleura sigmoidea* (?), *Stauroneis pulchella* (?), *Biddulphia* (*Amphitetras*) *antediluviana* ; embryonal shells of Bivalves ; *Entosolenia, Rosalina* ; *Codonella ventricosa* ; little fish-bones ; *Actiniscus, Dictyocha speculum* ; Sponge spicules.

STATION 24, lat. 44° 26′ N., long. 3° 55′ E., 49 fathoms.

Blue Mud with *Modiola phaseolina*, fragments of *Amphiura, Rosalina*, Ostracoda, *Biddulphia pulchella* (?).

STATION 25, lat. 43° 37′ N., long. 4° 19′ E., 1226 fathoms.

Blue Mud, blue-grey colour, extremely clayey, dries into lumps which require a blow from a hammer to break them.

CALCIUM CARBONATE (12·5%), almost entirely amorphous.

RESIDUE (87·5%), grey.

Minerals [5%], spherules of sulphide of iron, quartz, felspar, mica, green particles.

Siliceous Organisms [1%], Diatoms, Sponge spicules.

Fine Washings [81·5%], amorphous clayey matter, with minute mineral particles.

Organic remains observed : *Coscinodiscus, Biddulphia* (*Cerataulus*) *smithii* (?), *Actinoptychus undulatus* (?), *Navicula interrupta, N. elliptica, Pleurosigma, Nitzschiella lorenziana* (?), *Grammatophora marina, Actinocyclus, Striatella unipunctata, Cocconeis scutellum, Surirella fastuosa* (?), *Amphipleura sigmoidea, Melosira, Nitzschia* (*Tryblionella*) *punctata* (?), *Biddulphia* (*Amphitetras*) *antediluviana, Chætoceras, Rhizosolenia, Epithemia, Thalassiothrix ;* little *Rosalina* or *Rotalina ; Dictyocha speculum, Actiniscus.*

STATION 29, lat. 43° 12′ N., long. 8° 32′ E., 1157 fathoms.

Blue-grey Mud : after washing a blackish sand remains, principally quartz grains and spherules of sulphide of iron. Organic remains observed : *Coscinodiscus, Thalassiothrix, Rhizosolenia, Synedra, Cocconeis scutellum, Striatella unipunctata, Chætoceras, Hyalodiscus, Asterolampra, Grammatophora, Surirella fastuosa* (?) ; embryonal shells of Bivalves ; *Actiniscus, Dictyocha speculum* (?) ; mandibles of *Sagitta ;* vegetable matter.

STATION 30, lat 43° 12′ N., long. 9° 6′ E., 1009 fathoms.

Blue-grey Mud with a few white globules ; after washing there remains a blackish sand (of sulphide of iron spherules). Organic remains observed : *Hemiaulus hauckii, Rhizosolenia, Cocconeis scutellum, Synedra ulna, S. undulata, Coscinodiscus,* several species of *Chætoceras, Navicula, Surirella, Grammatophora serpentina, G. marina, Epithemia, Pleurosigma, Asterolampra, Amphipleura sigmoidea, Melosira* ; embryonic Bivalve shells ; *Dictyocha speculum, Actiniscus distephanus* ; *Textularia* ; Sponge spicules ; vegetable matter.

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STATION 33, lat. 41° 54′ N., long. 10° 53′ E., 567 fathoms.

Blue-grey Mud with a few white globules and spherules of sulphide of iron. Organic remains observed: *Coscinodiscus*, *Chætoceras*, *Rhizosolenia*; very many embryonic Bivalve shells; *Actiniscus*; *Codonella ventricosa*; a shell of *Textularia* having a sub-fossil appearance; vegetable matter.

STATION 34, lat. 41° 49′ N., long. 11° 3′ E., 220 fathoms.

Grey Mud with white spots, clayey, extremely coherent: the pieces require a blow from a hammer to break them.

CALCIUM CARBONATE (9·74%), mostly amorphous; a few small Bivalve shells observed.

RESIDUE (90·26%), a little darker.

Minerals [20%], m.di. 0·08 mm., angular, quartz, mica, felspar, hornblende, coloured and glassy particles, glauconite (?), spherules of sulphide of iron.

Siliceous Organisms [1%], Diatoms, Sponge spicules.

Fine Washings [69·26%], amorphous clayey matter, with many small mineral particles.

A detailed analysis gave:—

Insoluble silicates and clayey matter,	64·53
$Fe_2O_3 + Al_2O_3$,	6·73
$CaCO_3$,	9·74
$MgCO_3$,	5·04
Water, organic matter,	13·00
Sulphates,	trace
	99·04

Organic remains observed: *Coscinodiscus*, *Grammatophora marina*, *Podosira*, *Amphipleura*, *Diatoma* (*Odontidium*) *hiemale* (?), *Surirella gemma* (?), *Stauroneis*, *Synedra*, *Cymbella helvetica* (?), *Amphora quadrata* (?), *Hemiaulus hauckii*, *Cocconeis scutellum*; embryonal shells of Bivalves; fragments of *Amphiura*; *Dictyocha speculum*, *Actiniscus*.

STATION 35, lat. 41° 47′ N., long. 10° 17′ E., 973 fathoms.

Blue-grey Mud, with white layers, coherent, chalky.

CALCIUM CARBONATE (23·37%), mostly amorphous, but with one or two fragments of small Molluscs, and skeletal fragments of small fishes.

RESIDUE (76·63%), dark greenish grey.

Minerals [2%], m.di. 0·08 mm., angular, quartz, felspar, mica, hornblende, glauconite (?), glassy particles, and particles of sulphide of iron.

Siliceous Organisms [1%], Sponge spicules, Diatoms (some impregnated with sulphide of iron).

Fine Washings [73·63%], amorphous clayey matter, with many minute spherules of sulphide of iron, and small mineral particles.

Organic remains observed: Small Foraminifera; *Coscinodiscus*, *Grammatophora marina*, *Chætoceras*, *Melosira*, *Cocconeis*, *Synedra*, *Dictyocha speculum*.

STATION 38, lat. 41° 55′ N., long. 7° 12′ E., 1050 fathoms.

Blue-grey Mud with white globules and grains of sulphide of iron. Organic remains observed: *Coscinodiscus*, *Melosira*, *Rhizosolenia*, *Navicula didyma* (?), *Actiniscus*.

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STATION 39, lat. 41° 59′ N., long. 6° 12′ E., 387 fathoms.

This Station is specially referred to in the preceding general remarks on the deposits, and each layer is here described in detail:—

(1) **Light blue-grey Mud**, compact, clayey, with iron pyrites in the form of irregular nails, looking like small twigs, some 1 cm. in length.

CALCIUM CARBONATE (35·75%), mostly amorphous, but one or two small Gasteropod, Bivalve, and Ostracode shells were observed.

RESIDUE (64·25%), a little darker in colour.

Minerals [3%], m.di. 0·08 mm., mostly angular, quartz, felspar, mica, green particles (hornblende), glassy particles, and particles of pyrites of various shapes and sizes.

Siliceous Organisms [1%], one or two Sponge spicules.

Fine Washings [60·25%], amorphous clayey matter, with many mineral particles less than 0·05 mm. in diameter.

(2) **Green-grey Mud**, tenaceous, clayey, does not break down in water so readily as the light blue mud, and tends to separate into layers.

CALCIUM CARBONATE (16·0%), mostly amorphous, with a few white particles (having the appearance of organic fragments, but in reality crystalline sulphate of lime formed after collection?), small Mollusc shells, bones and scales of small fishes (*Singnathus*?).

RESIDUE (84·0%), greenish grey.

Minerals [2%], m.di. 0·06 mm., angular, quartz, felspar, etc.

Siliceous Organisms [1%], a few Sponge spicules.

Fine Washings [81·0%], amorphous clayey matter and minute mineral particles.

(3) **Stratified Mud**, of a blue-grey colour with white lines, along which the material splits up with ease; the mud between the white layers is very tenaceous and clayey, while the white layers are chalky.

CALCIUM CARBONATE (17·75%), principally in the form of minute elongated crystalline grains (about 0·01 mm. in maximum diameter), which constitute the white layers and small white spots, while the clayey layers contain amorphous carbonate of lime.

RESIDUE (82·25%), darker grey.

Minerals [2%], m.di. 0·06 mm., angular, quartz, felspar, mica, etc. The number of mineral particles exceeding 0·05 mm. in diameter is very small, and not one was observed exceeding 0·1 mm. There were a few white particles (having the appearance of organic fragments), which proved to be crystalline sulphate of lime (secondary formation after collection?).

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [79·25%], amorphous clayey matter, with very many minute mineral particles.

(4) **Dark blue-grey Mud** ("unwashed"), coherent, clayey.

CALCIUM CARBONATE (11·0%), mostly amorphous.

RESIDUE (89·0%) dark grey.

Minerals [15%], m.di. 0·1 mm., angular, quartz, black and white mica, felspar, hornblende, glauconite (?), glassy particles.

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Siliceous Organisms [1%], Sponge spicules, Diatoms.
Fine Washings [73·0%], amorphous clayey matter, with very many minute mineral particles.

STATION 40, lat. 42° 16′ N., long. 6° 12′ E., 1099 fathoms.

Light blue-grey Mud, with white patches, coherent.

CALCIUM CARBONATE (37·25%), mostly, if not entirely, amorphous; on picking out a little of the white material forming the patches it disappears entirely on treatment with dilute hydrochloric acid, leaving behind only a few small mineral particles. On washing, the white material, extremely fine-grained, forms a thin layer on the top.

RESIDUE (62·75%), green-grey.
Minerals [5%], m.di. 0·1 mm., angular, quartz, felspar, mica, hornblende, glauconite (?), coloured and glassy particles.
Siliceous Organisms [1%], Diatoms and Sponge spicules.
Fine Washings [56·75%], flocculent amorphous clayey matter, with many small mineral particles.

STATION 41, lat. 42° 48′ N., long. 4° 40′ E., 1187 fathoms.

Blue-grey Mud. Organic remains observed: *Coscinodiscus, Melosira communis, Epithemia, Rhizosolenia, Navicula elliptica* (?); small Foraminifera shells; *Actiniscus, Dictyocha speculum*; knobby Sponge spicules.

STATION 45, lat. 44° 15′ N., long. 1° 58′ E., 817 fathoms.

Light blue-grey Mud, with white lines and patches, coherent, chalky.

CALCIUM CARBONATE (46·83%), mostly amorphous, with a few bones of small fishes.

RESIDUE (53·17%) dark greenish grey.
Minerals (1%), m.di. 0·07 mm., angular, quartz, mica, felspar, spherules of sulphide of iron.
Siliceous Organisms (1%), Diatoms and Sponge spicules.
Fine Washings (51·17%), flocculent and amorphous clayey matter impregnated with sulphide of iron, and small mineral particles.

Detailed analysis gave:—

Insoluble silicates and clayey matter,	31·28
$Fe_2O_3 + Al_2O_3$,	4·43
$CaCO_3$,	46·83
$MgCO_3$	3·48
Water, organic matter,	13·96
Sulphates,	fairly large trace
	99·98

Organic remains observed: *Coscinodiscus, Navicula, Cocconeis scutellum, Grammatophora*; embryonic shells of Bivalves; Sponge spicules; *Codonella ventricosa, Actiniscus*; vegetable matter.

STATION 46, lat. 43° 53′ N., long. 0° 58′ E., 748 fathoms.

Grey-blue Mud, with white spherules. Organic remains observed: *Coscinodiscus, Codonella ventricosa*, and vegetable matter.

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STATION 48, lat. 42° 32′ N., long. 0° 30′ W., 1184 fathoms.

Light blue-grey Mud, with white patches and layers, chalky, coherent.

CALCIUM CARBONATE (64·5%), amorphous.

RESIDUE (35·5%), greenish.

Minerals (1%), m. di. 0·06 mm., angular, mica, quartz, felspar, etc., many spherules of sulphide of iron.

Siliceous Organisms (1%), Diatoms, Sponge spicules.

Fine Washings (33·5%), flocculent and amorphous clayey matter, with a few small mineral particles.

STATION 50, lat. 43° 32′ N., long. 0° 45′ W., 47 fathoms.

Modiola Mud, some of the shells blackened by manganese. Other organic remains observed: Foraminifera (*Rotalina*, *Entosolenia*, *Dentalina*), spicules of Monaxonid and calcareous Sponges.

STATION 51, lat. 44° 20′ N., long. 0° 40′ E., 65 to 107 fathoms.

Modiola Mud, some of the shells have a deposition of iron and manganese around the edges. Other organic remains observed: *Bulla truncata*, Foraminifera (*Entosolenia*, *Lagena*, *Rotalia*), Sponge spicules, and, in the deeper water, subfossil shells of *Dreissensia*, etc.

STATION 52, lat. 44° 20′ N., long. 0° 17′ E., 45 fathoms.

Modiola Mud (some of the shells impregnated with manganese and iron), very fine grained, almost without sand, with few microscopic organic remains (*Rosalina*, *Entosolenia*, *Cornuspira*, an arenaceous Foraminifera, *Coscinodiscus*, *Melosira*.)

STATION 53, lat. 44° 37′ N., long. 0° 6′ W., 35 fathoms.

Modiola Mud. Organic remains observed: *Coscinodiscus*, *Cocconeis*, *Grammatophora serpentina*, *Navicula lyra*, *N. elliptica*, *Amphipleura sigmoidea*, *Biddulphia antediluviana*, *Surirella fastuosa* (?), *Hyalodiscus*, *Striatella unipunctata*, *Amphora crassa*; *Dictyocha speculum*, *Actiniscus*; Sponge spicules; little *Rosalina*.

STATION 55, lat. 15° 45′ N., long. 0° 1′ W., 25 fathoms.

The bottom is covered by *Mytilus* shells, overgrown by large knobs of *Lithothamnion*, and with many *Phyllophora*; some of the shells impregnated in places by manganese and iron. The growths of *Lithothamnion* are almost entirely confined to the external surfaces of the shells, as though the separated valves lay on the bottom internal surface downwards, some of them still retaining something of the iridescent lustre of the fresh shell, while others are much decomposed.

STATION 57, lat. 46° 5′ N., long. 1° 0′ E., 16 fathoms.

Sandy Black Mud. Organic remains observed: *Mytilus edulis*, *Cerithium*, Ostracoda, many Diatoms: *Navicula lyra*, *N. interrupta*, etc., *Coscinodiscus*, *Cocconeis scutellum* (?), *Campylodiscus parvulus* (?), *Nitzschia* (*Tryblionella*) *marginata* (?), *Grammatophora marina*, *G. macilenta*, *G. serpentina*, *Synedra undulata*, *S. ulna* (?), *Surirella fastuosa* (?), *S. gemma* (?), *Pleurosigma*, *Amphiprora*, *Epithemia*, *Actinoptychus undulatus*, *Amphipleura sigmoidea*, *Amphora crassa*, *Achnanthes longipes*, *Striatella unipunctata*; *Rosalina*, *Textularia*; *Dictyocha speculum*, *Actiniscus*.

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STATION 58, lat. 46° 14′ N., long. 0° 49′ E., 14 fathoms.

Dark blue-grey Mud, with Mollusc shells and fragments, extremely coherent.

CALCIUM CARBONATE (18·0%), amorphous calcareous matter, with fragments of Mollusc shells, Ostracodes, and Foraminifera.

RESIDUE (82·0%), dark brownish grey.

Minerals (10%), m. di. 0·12 mm. (one particle 0·6 mm. in diameter observed), angular, quartz, felspar, mica, hornblende, glauconite (?), glassy particles, spherules and irregular particles of pyrites.

Siliceous Organisms (2%), many Diatoms (some impregnated with sulphide of iron), Sponge spicules, arenaceous Foraminifera.

Fine Washings (70%), amorphous clayey matter, with many minute spherules of sulphide of iron and small mineral particles.

Organic remains observed: Ostracoda; *Rotalina* and many arenaceous Foraminifera; *Dictyocha*, *Actiniscus*; Diatoms: *Melosira*, *Navicula*, *Nitzschia scalaris*, *N.* (*Tryblionella*) *marginata* (?), *Surirella*, *Cocconeis*, *Pleurosigma*, *Grammatophora macilenta*, *Coscinodiscus*, *Epithemia*, *Striatella unipunctata*.

STATION 59, lat. 46° 21′ N., long. 0° 42′ E., 15 fathoms.

Blue-grey Mud, black when collected but becoming grey in the air.

Organic remains observed: *Gromia*; *Rosalina*; Diatoms: *Navicula* several species, *Surirella fastuosa* (?), *Nitzschia punctata* (?), *Melosira*, *Amphiprora*, *Epithemia*, *Achnanthes*, *Grammatophora marina*, *Stauroneis pulchella*, *Pleurosigma*, *Amphora*, *Amphipleura sigmoidea*, *Coscinodiscus*; *Dictyocha*; Sponge spicules; Ostracoda.

In conclusion, we may remark that the most striking differences between the deposits of the Black Sea and deposits from similar depths in the open ocean are:—(1) greater proportion of clayey matter and smaller proportion of mineral particles in the Black Sea muds; (2) glauconite may be said to be absent from the Black Sea, only a few doubtful grains having been observed; (3) the carbonate of lime is almost entirely amorphous (and in one case crystalline) in the Black Sea muds, whereas in the open sea it is almost entirely composed of remains of pelagic organisms; (4) the total absence of pelagic organic remains (except Diatoms) in the Black Sea muds; (5) the great abundance of sulphide of iron in the deposits from the Black Sea.

MOUNT ST. ELIAS: A REVIEW.[1]

IN intrusting the record of his expedition to the summit of Mount St. Elias to the pen of Dr. Filippo de Filippi, the Duke of the Abruzzi has most assuredly chosen one who has accomplished the task he had before

[1] *La spedizione di sua Altessa Reale il Principe Luigi Amedeo di Savoia, Duca degli Abruzzi al Monte Sant' Elia* (*Alaska*), 1897. (Milano: U. Hoepli, 1900.)

The Ascent of Mount St. Elias (*Alaska*). *By H.R.H. Prince Luigi Amedeo di Savoia Duke of the Abruzzi.* Narrated by Filippo de Filippi; illustrated by Vittorio Sella; and translated by Signora Linda Villari, with the author's supervision. Pp. xii+241. 34 photogravure plates, 4 panoramic views, 117 illustrations in text, and 2 maps. (Westminster: Archibald Constable and Co., 1900.)

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him with success. The narrative is compiled from the diaries of his Royal Highness and from those of the other members of the expedition, including Dr. de Filippi himself. His Royal Highness's expedition was exclusively Alpinistic. Its sole object was to reach the summit of Mount St. Elias, and all else was naturally subordinated to that aim. "The whole profit on the sale of the Italian edition, together with all royalties and rights on foreign editions, will be dedicated to an insurance fund for Italian guides." The ascent adds another record to those fine feats which make men courageous, patient, and enduring, and made one look forward with eager interest to the results of the Prince's latest expedition towards the North Pole itself from the shores of Franz Josef Land, in which he has again, with the help of Captain Cagni and his other companions, achieved such splendid results.

The opening chapters deal with the journey from Turin to Yakutat Bay, whence the ascent was made. Then comes an excellent summary of the history of the discovery and exploration of Mount St. Elias. "Most geographers apply the name of 'St. Elias Alps' to the whole mountain system bounded by St. Elias to the north and La Pérouse to the south. For a long stretch of about 180 geographical miles these Alps run parallel with the Pacific coast, and separated from the sea by a narrow strip almost entirely covered by the mighty glaciers flowing down from the range. Yakutat Bay, thrusting inland by the narrow and tortuous fiord known as Disenchantment Bay, divides the mountains into two groups, consisting of the Fairweather chain to the south, and of the Cook and St. Elias chains to the north." It was Behring who discovered this coast and Mount St. Elias in 1741, and the mountain was first measured by La Pérouse's expedition in 1786, and by calculations Mons. Dagelet, the astronomer, made it 12,672 feet. In 1792 an Italian, Malaspina, captain of a Spanish expedition for the North-West Passage, fixed the height as 17,857 feet, and its position as 60° 17′ 35″ N., 140° 52′ 17″ W. (Greenwich). Vancouver also explored these coasts, and made observations in Yakutat Bay which indicate a rapid retreat of ice since his day. Until 1874 Mount St. Elias was believed by many to be an active volcano, though subsequent explorations show no trace of volcanic action in the St. Elias group; in that year the "United States Survey" despatched W. H. Dall and M. Baker, "who gleaned a rich harvest of geographical and geological data, and much new information on the glacial phenomena of that region." The height was calculated as 19,600 feet, and the position of the mountain as 60° 20′ 45″ N., 141° 0′ 12″ W. (Greenwich). The first real ascent expedition was sent out by the *New York Times* in 1886, under Swatka, Libbey, and Seton-Karr. They landed at the Yahtse river in heavy surf, and Seton-Karr reached 7200 feet *viâ* Tyndal glacier. In 1888 three British Alpinists, W. H. and E. Topham and Brooke, and Williams of New York, landed with great difficulty and tried the ascent *viâ* Libbey glacier. Owing to avalanches of ice and snow, this was impossible, but they ascended 11,460 feet *viâ* Tyndal glacier when they were stopped by a cliff, coated with blue ice and 1500 feet high. In 1890 the U.S. Geological Survey and National Geographic Society despatched Prof. Israel C. Russell with Kerr. Russell landed in the north corner of

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Yukutat Bay. "Although so far from the mouth of the bay, they found the beach lined with white breakers, luckily not formidable enough to prevent landing in ordinary weather." He ascended and travelled north-westward along the Cook chain till he reached Blossom Island, a spur clothed with firs and gay with flowers, and lying between Marine and Hayden glaciers; this took him thirty-one days from the coast. He then crossed Pinnacle Pass, named Mt. Logan, lying north of Mt. Augusta; crossed the Seward glacier to Agassiz glacier westward, and thence attempted the ascent *viâ* Newton glacier. After great hardships with violently bad weather, with snow-storms and rain, he was compelled to

Mount St. Elias, from the third Newton Cascade.

turn back, for "in spite of Russell's tenacious and often rash courage there was no longer any hope of conquering the peak." In 1891 Russell was sent out again and landed at the Yahtse river, after a serious accident involving the loss of six men. He travelled *viâ* Chaix hills. Agassiz and Newton glaciers, and after six weeks reached 14,500 feet, He measured the heights of the chief summits by triangulation, and St. Elias was found to be 18,100 feet. He explored Disenchantment Bay, and here and elsewhere found an extensive retreat of the ice.

The Prince and his party landed at the mouth of the Osar stream, where Cagni found a suitable landing. The camp consisted of twenty-

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five men—including Indian porters—and ten tents. He crossed the belt of the moraine, which is from four to six miles wide and about eighty miles long and 500 feet high, and girdles the foot of the great fan-shaped Malaspina glacier. Russell classes the Malaspina glacier as a "Piedmont" glacier, as distinguished from the "Alpine" type, which consist of affluents flowing down into valleys; it is the widened snouts of three great glaciers which flow down on to a great plateau. Travelling in an almost northerly direction, Hitchcock range was reached and an ascent of the Seward glacier made across the foot of the Pinnacle Pass. At the junction of the Pinnacle with the Seward glacier is an ice cascade,

Small lake among the Newton Séracs.

where the ice is of the roughest possible description. The Hitchcock range and Blossom Island, clothed with thickets of dwarf shrubs and pines, dark blue lupins, violets, anemones, saxifrages, and moss, make this region a "veritable oasis of colour and fragrance in the midst of the lifeless waste of ice."

"The aspect of the Seward was somewhat different in 1890, when Russell first saw and described it." He and Kerr relate how the séracs crashed down and shook the ice under their feet, and how there were incessant reports and rumblings of falling blocks. Nothing of this kind was observed by the Prince. The Seward glacier was crossed on the 10th of July by a tortuous route owing to crevasses. They "kept a course parallel with the huge *crevasses* along strips of ice scarcely wider

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than the sledge, and sometimes across square blocks connected by snow bridges," until at length Dome Pass was reached. From this point the course was in a direction slightly to the north of west across Agassiz glacier and up Newton glacier up to the col, where Russell was forced to turn back, and which the Prince has named Russell Col; from the ridge of Russell Col the final ascent of St. Elias was made, travelling in a south-westerly direction. "The leading characteristics of all the great glaciers in this region—namely their division into terraces connected by ice-falls—is more obvious in the Newton than in any others." "The ice-falls increase in height as the valley rises," and the slope of the terraces

South Wall of Newton Glacier, and the Savoia Glacier at its confluence with the Newton.

is almost level and may actually be reversed. The ascent of Newton glacier was one of the most arduous pieces of work. It is eight miles in length, and took the expedition thirteen days to cover that distance. It was heavy walking through powdery snow, in which they often sank to their hips, while they had to grope their way patiently among the great blocks of ice, over snow-bridges, often insecure, and amid the incessant roar of avalanches and stone-falls which thundered down from morning till night on the margins of the glacier. They only had three fine days out of the thirteen. "In spite of persistent bad weather," de Filippi says, "our days on the Newton glacier were neither monotonous nor wearisome. The scenery revealed such wealth of colour and form, that every day, in all

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sorts of weather, some novelty was seen, some endless succession of unexpected views. The glacier is usually blue—and of a deeper blue in mist than in sunshine—not greenish, as on Alpine ice-fields. This colouring pervades the air, and is caught and reflected by the mist, until everything is bathed in a transparent azure. The effect is so constant and so marked, although in varying degrees of intensity, that this might appropriately be named Blue Valley." On this Newton glacier the snow fell thickly, and the white mist was blinding; travelling, they were unable to realise inclinations, shallow depressions appeared as bottomless gulfs, and their elbows and pack scraped on walls of snow which they thought

Dome Pass.

to be flat. At length, on 28th of July, they reached the base of Russell Col, and camped at an elevation of 8661 feet. Next day they pitched camp just beneath the crest of the col, at an elevation of 12,297 feet, where they rested till midnight of July 30th. The ascent of Mount St. Elias itself was then begun, and the summit was reached after a very trying and arduous climb of ten and a half hours' duration. The ascent was fortunately favoured by "completely calm weather, and an ideal temperature, unusual in the high mountains, neither inconveniently cold nor oppressively hot." Approaching the end of their ascent, they experienced the typical symptoms of over-fatigue, and their ascent was

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slow. The Prince, Sella, and two guides alone not showing signs of distress. Drowsiness overcame some, headache and mountain sickness appeared. Their legs seemed like lead, and each step required an effort of the will. At last the summit was reached. "Every trace of fatigue disappeared in the joy of success!" This moment was the reward of their thirty-eight days of labour and hardship. The tricolour was hoisted, and cheers were given for Italy and the king. The Fortin barometer marked a pressure of fifteen inches and two lines, which indicated a height of 18,090 feet—a remarkable approximation to Russell's estimate, namely 18,100 feet. The only other result which approached correctness was Malaspina's estimate of 17,847 feet. "Beneath us," says Filippi, "on every side, lay an indescribable panorama, glittering in the intense midday light. Only the Malaspina glacier and the sea were covered by a low-hanging curtain of fog; in every other direction the horizon was perfectly clear. The enormous extent of snow-fields, glaciers, and mountains revealed to our sight surpassed all imagination." Long glissades bore them quickly down the slopes they had so laboriously toiled up, and crevasses, now filled with snow, were easily passed. On the 3rd of August they reached the American porters, who cheered them on hearing of their success; at about 3000 feet they emerged from the snow-line, and, descending at an extremely rapid pace, reached the moraine on the 10th of August. Here all but the most precious part of the baggage—such as instruments and other necessities—was abandoned, and the shore was reached next day. Before they had been an hour on the beach they were driven wild with mosquitoes. These swarmed about in dense clouds; got into their noses, mouths, eyes, ears; crawled up their sleeves and down their collars. Before long their faces were like masks, all swollen and blood-stained by the innumerable stings, and the vain slaps and scratchings by which they sought protection or cure. With some difficulty they embarked through the surf, and, reaching the yacht *Aggie*, started homewards.

Altogether the volume is most attractive. Anybody who knows what ice scenery is will be delighted with the descriptions and illustrations, and those who do not will assuredly gain a more vivid idea of what ice scenery is. It is the best illustrated book of travel that the reviewer has seen; the photogravures are remarkably beautiful, reminding one in many respects of the beautiful steel engravings of old—in fact, being more chaste and expressive even than these. The frontispiece, showing the top of Mount St. Elias from the east; that facing page 122, Newton Valley, and that facing page 126, the séracs of Newton Valley, are exceptionally fine. But all are good. The panoramic views at the end are very instructive, and the two maps are good and useful.

There are slips in the translation of minor importance, and the translation loses some of the vigour and brightness of the original, though on the whole it is good. The print and the paper are good, likewise the binding. *But!* But why no index? W. S. B.

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THE DUKE OF ARGYLL, K.G., K.T.,

Formerly President of the Society.

WHEN on 24th April last the Duke of Argyll died, the Nestor of British politics, perhaps also of British science, passed away. Born in 1823, he took his place in public life very early, having, when only nineteen, startled Scottish ecclesiastical circles by the views expressed in a pamphlet entitled, "A Letter to the Peers from a Peer's Son."

A witty Scottish nobleman is alleged to have remarked, when search was being made for a biographer of the late Mr. Gladstone, that it would require a joint-stock company to write Mr. Gladstone's *Life*. The same remark applies to the late Duke of Argyll. There was no field of human thought which he did not enter, no region of Science which he did not explore, there was nothing in Nature which did not interest him, and there were few subjects upon which he could not discourse.

Four years after his succession to his father as eighth Duke of Argyll, he was in 1851 installed as Chancellor of the University of St. Andrews, and two years later he was elected Lord Rector of the University of Glasgow. In 1855 he presided over the British Association for the Advancement of Science at its meeting in Glasgow. From 1860 to 1864 he was President of the Royal Society of Edinburgh. He received the degree of LL.D. from Cambridge University in 1862, and that of D.C.L. from the University of Oxford in 1870. For several years he acted as a member of the Committee of Council on Education in Scotland. He was President of our Society from November 1889 to November 1894.

His position as a Statesman does not fall within this notice, but it may be mentioned that, as a Cabinet Minister, the Duke of Argyll held the office of Lord Privy Seal under Lords Aberdeen and Palmerston, and became Postmaster-General in 1855, whilst in Mr. Gladstone's ministry of 1868 he was Secretary of State for India, and in that of 1880 Lord Privy Seal. His scientific bent frequently appeared in the speeches he delivered, as when, alluding to the American Civil War, he remarked in 1861: "There is a curious animal in Loch Fyne which I have sometimes dredged up from the bottom of the sea, and which performs the most extraordinary and unaccountable acts of suicide and self-destruction. It is a peculiar kind of starfish, which, when brought up from the bottom of the water, and when any attempt is made to take hold of it, immediately throws off all its arms, its very centre breaks up, and nothing remains of one of the most beautiful forms in Nature but a thousand wriggling fragments. Such undoubtedly would have been the fate of the American Union if its Government had admitted what is called the Right of Secession."

The Duke was an admirable scientific lecturer. When President of our Society he delivered, on 10th February 1890, an address upon "Border-Lands between Geology and Geography," and, describing the glaciation of Greenland, he explained diagrams with a facility which showed that public lecturing was to him as easy as to any University

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From Photogravure of a Painting by William Wontner

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Professor. With equal vigour and success he delivered in the lecture-room of the Edinburgh Museum of Science and Art an address on "Continuity and Catastrophes in Geology" on 1st November 1883, when the Edinburgh Geological Society celebrated its fiftieth anniversary.

As a Field Geologist, the Duke had long before achieved considerable celebrity by his interesting discovery in 1851 of several bands of Tertiary strata, containing leaves of dicotyledonous plants, in the sea-cliffs forming the headland of Ardtun on the west coast of Mull. These leaf-beds were covered by a sheet of basalt, and the Duke's discovery was declared by Sir Charles Lyell to raise the question whether the basalt of Antrim in Ireland and the famous Giant's Causeway may not be of the same age as that of Mull.

The Duke of Argyll's most widely known publications are probably those entitled *The Reign of Law*, *Primeval Man*, and *The Unity of Nature*. These were works in which Science was blended with philosophical and theological considerations, after the manner of Hugh Miller, and discussed with the same Celtic fervour and natural eloquence.

Not only did the late Duke sail constantly in his yacht and explore the most unfrequented shores of the Western Highlands, not only was every feature of that wild coast familiar to his eye or chronicled in his sketch-book, but also he took a deep interest in several sciences essential to a thorough knowledge of Geography. As a Naturalist, above all an Ornithologist, as a Geologist, as a Meteorologist, and as an Agriculturist, he held high rank, breaking even a lance with Charles Darwin on the subject of Natural Selection, and having his Objections to Darwin's theory enshrined in Lyell's classic *Principles of Geology*.

His monograph on the island of Iona, which belonged to him, is written for general rather than scientific readers, yet few landowners have so truly or eloquently described interesting portions of their property; while none have more keenly surveyed the field of political and social economy than did the late Duke in his *Scotland as it Was, and as it Is*, a work which was illustrated from its author's own sketches, which represent with scrupulous accuracy the outlines, surfaces, and structure of several mountainous Scottish districts.

Scotland will miss the intellectual searchlight which streamed from Inveraray Castle, where every leader of science has been a welcome guest during the past half-century, and from whence issued original views upon every subject. There "The MacCallum More" lived in true Highland dignity and state, but not in luxury or idleness, for every day of his long and useful life was spent in the study of Nature, and in the cultivation of his mind.—R. R.

The accompanying portrait is taken from a photographic copy, presented to the Society by the Duchess Dowager, of a recent oil-painting by William Wontner.

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PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meeting of Council.

A meeting was held on November 13th, when the following business was transacted.

The under-mentioned ladies and gentlemen were elected members of the Society:—

Mrs. J. J. Kinnear.
Mrs. Dawson.
Miss E. J. Lindsay, L.L.A.
Lord Provost Hunter (*Dundee*).
H. S. Wallace, B.A., W.S.
John E. Turnbull.
Walter W. Blackie, B.Sc.
Thomas A. Rooper, M.A.
E. M'Arthur Moir.
Rev. Dr. Milne Rae.
William Sheers.

The Society's Medal and Diploma of Honorary Fellowship were conferred on Mr. C. E. Borchgrevink, in recognition of the work done by him as leader of the *Southern Cross* Antarctic Expedition.

A Resolution was passed expressing the Council's sense of the loss sustained by the Society through the death of Sir John Cowan, Bart. A copy of the Resolution was ordered to be communicated to his family.

The Annual Business Meeting

was subsequently held, on the same day, in the Society's Hall. Mr. J. B. Sutherland presided.

Mr. Ralph Richardson, Hon. Secretary, acting on behalf of the Council, and in conformity to the provisions of Law No. XXV., gave notice of a motion to alter Law No. XI. and Law No. XXVII. as below stated:

In Law XI. the words, "the Chairmen of the Society's Branches" shall be added after the words "the Trustees."

Law XXVII. shall be altered and shall read as follows:—"The property of the Society shall be vested in not fewer than three Trustees."

Sir John Murray, K.C.B., was re-elected President.

The Vice-Presidents were re-elected, the names of Viscount Melville, Lord Elphinstone, and Lord Kinnear being added to the list.

The following Members of Council, who retire by rotation, were re-elected:—Sir Mitchell Mitchell-Thomson, Bart., Sheriff Æ. Mackay, J. B. Sutherland, William C. Dunbar, C.B., Dr. Alexander Buchan, F. Grant Ogilvie, Dr. Knott, William C. Smith, Coutts Trotter, H. B. Finlay, W. F. G. Anderson (*Glasgow*), L. F. U. Garriock (*Dundee*).

The following members of the Society were elected to the Council to fill vacancies:—Hon. J. Abercromby, Sir Alex. Christison, Bart., H. M. Cadell, John Harrison, Colonel Wardlaw Ramsay, Sir John Neilson Cuthbertson (*Glasgow*), A. Crosbie Turner (*Glasgow*), Henry Dyer, D.Sc. (*Glasgow*), and John Clarke, M.A. (*Aberdeen*).

Mr. James Currie was appointed one of the Society's Trustees in room of the late Mr. James Currie, senior.

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The report of Council, which is printed at the end of this number of the *Magazine*, was adopted.

Meetings in November.

The anniversary meetings of the Society were held as follows:—At Edinburgh on the 14th, in the Synod Hall, Lord Balfour of Burleigh, Vice-President, in the Chair; at Glasgow on the 13th, under the Chairmanship of Sir John Neilson Cuthbertson; at Dundee on the 16th, Mr. I. J. Weinberg presiding; at Aberdeen on the 15th, Mr. John Clarke, M.A., in the Chair. All these meetings were addressed by Mr. C. E. Borchgrevink, leader of the *Southern Cross* Antarctic Expedition.

Meetings for December.

Mrs. Fanny Bullock Workman will address the Society on her Ascents of High Peaks of the Himalaya as follows:—At Edinburgh on the 6th, at Glasgow on the 4th, at Dundee on the 12th, and at Aberdeen on the 10th.

On the 13th, Mr. Alfred Sharpe, Commissioner and Consul-General for British Central Africa, will address the Society in Edinburgh on "Trade and Colonisation in British Central Africa."

GEOGRAPHICAL NOTES.

EUROPE.

Royal Geographical Society.—The new session of the Society, which began on November 12th, was introduced by an address by Sir Clements Markham, followed by a paper by Dr. A. Donaldson Smith on his recent remarkable journey through Somaliland to Lake Rudolf, from thence to the Nile and home by Khartum and Cairo. On November 26th, Mr. J. E. S. Moore read a paper on the results of his recent scientific exploration of Lake Tanganyika and the interesting lands to the north, and at the meeting of December 10th, Major Gibbon will give an account of his recent journey through Africa to the Mediterranean, especially his exploration in the Barotse country. Among the papers expected after Christmas are one by Colonel G. E. Church on the Geography of South America, particularly in reference to its commercial development, another on "Further Studies in Wave Forms," by Mr. Vaughan Cornish, and it is expected that the Duke of Abruzzi will give an account of his recent remarkable Polar expedition.

The Royal Society.—Among the Society's medals, which have been adjudicated by the President and Council, a Royal medal has been awarded to Professor Alfred Newton, F.R.S., for his eminent contributions to the science of Ornithology and the geographical distribution of animals, and the Darwin medal to Professor Ernest Haeckel for his long-continued and important work in Zoology.

Railways in Russia.—A new line between Odessa and St. Petersburg is meditated. The two cities stand on the same meridian of longitude. The distance between them, as the crow flies, is about 950 miles, while the present railway traverses a route which covers over 1200 miles, going far to the west and passing Warsaw. The new line would run through Kieff (population 260,000) Moghileff (45,000), and Vitebsk (70,000), with short branches extending to Chernigoff and Novgorod. Besides uniting these important towns, the railway

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would reduce the distance between Odessa and St. Petersburg by nearly a quarter, and the time by twenty-two hours.

Bulgarian Railways.—On October 21st, Prince Ferdinand inaugurated the new railway from Rustchuk to Tirnova. The new line completes a network of railways which opens up the rich agricultural districts of northern Bulgaria.

ASIA.

The Overland Trade from India to Persia.—The Commercial Intelligence Branch of the Board of Trade have received, from the agent to the Governor-General in Baluchistan, a copy of a memorandum relating to the trade between Quetta and Sistan and Birjand by the new Nushki road between India and Persia, drawn up by Messrs. Muhamad Ali and Brothers, who are said to be the first Indian traders to open up a regular trade by means of this route.

The Sistan district was found to be very poorly supplied with European merchandise, supplies being imported from Birjand—the capital and centre of trade of Kainat (Eastern Persia)—at high rates, and a consignment of fancy goods of English manufacture, very freely assorted, was offered at low rates in order to give publicity to Messrs. Muhamad Ali and Brothers' business. The Deputy-Governor of Sistan, together with the chiefs and other influential persons, made purchases, also the Russian Vice-Consul, who asked to be supplied with tents, portable soda-water machinery, etc. The governor expressed his desire to see the rapid development of British trade in these regions. The local merchants, of whom there are many in Birjand with a capital of from 20,000 to 30,000 rupees, only offered the wholesale rates prevailing at Bander-Abbas, so the goods were being sold retail. Both English and Russian goods are imported, sugar coming from Russian territory and also from Shahjahanpur (Indian North West Provinces), and though articles of British manufacture fetch higher prices in the market, Russian products, such as cotton goods, tea, sugar, etc., were for sale at such low rates, that although the natives preferred British manufactures, it was impossible to compete with Russia in these goods. Inquiries into the reason for this revealed the information that at Birjand and other parts of Persia a bounty was allowed on such articles. The exports from Sistan are wool, ghi, down and feathers, carpets, and asafœtida, etc., also opium by way of Bander-Abbas, while those from Birjand consist of wool and skins to Russia and Bander-Abbas, carpets to Russia, Europe, and India, barak—a woollen material—to parts of Persia, opium to China *vid* Bander-Abbas, and saffron and carraway seed, by the same route, to India.

The Indigo Industries.—Now that the German Badische Anilin Soda Fabric Company is, by the experiments of Professor Neumann of Zurich, enabled to place indigo upon the markets at prices and quantities—the amount annually produced in Ludwigshafen would require the cultivation of a quarter of a million acres of the land of India—which compete favourably with the native product, a serious menace confronts the indigo industry of India. In the commercial world, the artificial is everywhere supplanting the natural. While the development of the manufacture is gaining enormous proportions, that of the cultivation of indigo is in danger of dying out. About £900,000 has been invested in the indigo department and laboratories of the Badische Company. In 1897, factories were built sufficient to supply the demand for indigo in Germany, and built in such a manner as to form part of a larger scheme, if successful. Although success was not at first altogether certain, as vegetable indigo might have been able to stand considerable

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reduction in price, and other chemical processes might have been discovered for the manufacture of the drug, the industry is now an established one.

Behar, the most densely populated province of India, and that most given to the cultivation of indigo, is thus threatened with a withdrawal of a quarter of a million of pounds, yearly spent by the planters upon hired labour, a loss which could not be balanced by the reversion of indigo cultivation to that of country produce. Now that the indigo industry is shrinking, the production of sugar, which, before 1840, was grown and manufactured in Behar as an European enterprise, only fading into insignificance before the rising prospects of indigo, is beginning to attract attention. Sir William Hudson, K.C.I.E., late president of the Behar Indigo Planters' Association, presented an application to the Bengal Government asking for pecuniary assistance to resuscitate the cultivation of sugar, and the Government, taking into account the unique facilities afforded by the estates of North Behar, is inclined to grant the desired encouragement.

In the light of Sir William Hudson's research, the old conditions appear to be changed. Railways and good roads, together with improved canes and modern machinery, which nearly doubled the quantity of first-class sugar obtainable per acre by the old methods, promise to have success if the initial capital is forthcoming.

Shan-Hai-Hwan, which has been occupied by the Allies, in order to provide for a winter occupation of Northern China, is an important strategic position situated on the Pe-chi-li coast, midway between the treaty ports of Tien-tsin and Niu-chwang, about 150 miles north-east of the former, where the mountain range dividing Chi-li from southern Manchuria approaches within three or four miles of the sea. It commands the easiest route along the plain from the north-east to the capital, which consideration prompted the first emperor, Shih Hwang-Ti, to select it as the starting-point of the Great Wall, the same reason deciding that the Northern Chinese Railway should pass through the narrow neck of lowland lying between the mountains and the sea. Shan-hai-hwan, (the Gate of the Maritime Mountains), is a walled town with whose ramparts the Great Wall is incorporated. The railway station lies several hundred yards to the south. The town itself, the name of which is not certain — on Waeber's map it is marked Lin Yu, while other travellers call it Shan-hai-wei—is essentially a Chinese town, with battlements and ramparts, conspicuous and picturesque, and with tumble-down, one-story buildings. The Great Wall, first encircling the village of Ning-hai, farther on passes Shan-hai-wei, of which it forms the eastern wall, and proceeds along the yellow plain. Looking northward from the town it is seen meandering across the plain and zig-zagging up the mountain side till it crawls over the crest. The wall possesses a political importance, as it forms the boundary of our railway sphere of interest in these regions. It lies only a few miles north-east of the harbour of Ching-wang-tao, which is almost ice-free in winter; and any force occupying it would not only be in touch with the warships of the Powers, but would also be able to control the railway eastward to Niu-chwang, and westward to Tien-tsin, which ports, being frozen for three months in the winter, are not open to regular navigation.

The Russian-Manchurian Railway.—The Russian Government—even before the military operations in that country have entirely ceased—are hurrying forward the work of their great railway enterprise in Manchuria. The chief engineer of road and railway construction beyond Lake Baikal has informed the military commander of the trans-Baikal territories that the branch railway which deflects from the main Siberian trunk-line at the station of Kaildatova, west of Nertchinsk and

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proceeding as far as Hailar on the Manchurian frontier, will be ready for the transport of troops by the end of February next, if the delivery of rails and fastenings, which, to save time by carriage, have been ordered from works in the Urals, are not delayed. This branch line will join the north-western section of the Manchurian railway, which is being hurriedly proceeded with for military reasons, and will facilitate the movement of troops along the Hailar, Tsitsihar, and Harbin route, Harbin being the chief Russian settlement and depot. Strategical roads are being constructed between Stretensk and Tsuruhaiti on the river Argun, which forms the border of Manchuria, and also between Undurga and Sibir.

The means of communication east of Lake Baikal are in a very inferior condition, everything giving way to the requirements of the military. The line is provisionally open to the public, but there is no regular time-table or railway guide-book, and it is not possible to book straight through by the weekly Siberian express from Moscow farther than Irkutsk. Farther than that the line is unsafe at present.

On October 19, M. Kerbets, the Russian vice-president of the Chinese Eastern Railway and the chief authority under M. Witte of the railway enterprise in Manchuria, started from St. Petersburg for the Far East, with members of a special commission, in order to complete an estimate of the damage done to the railway and Russian property in Manchuria, for which Russia will present a separate demand to the Chinese Government.

Korea, suffering from the effects of her unfortunate geographical position, to which is due her long dependence upon China, although such dependence so-called was severed by the Treaty of Shimonoseke, is still, writes a correspondent of the *Times* from Seoul, generally connected with that biting giant, so that the disturbances in China are still reflected in Korea. Thus the recent massacres in China, according to the Japanese, led, in Korea, to the murder of 150 foreigners. In spite of the reaction against the radical programme which in the first ecstasy of independence was introduced, her government is influenced in about the same degree as that of Japan by the proceedings at Pekin. Yet the country is distinctly conservative, refusing, because she cannot follow the example of Japan, for which feudalism had prepared the way, to throw off the incubus of immemorial custom and prejudice; and Japan, moreover, in endeavouring to modernise the country by forcing the people to cut off the "top-knot" and discard long sleeves, not only failed utterly, but demonstrated a fact—which has been noted—that whatever are her capacities for Home Government, she does not possess those qualities of colonisation which might enable her to become the Great Britain of the East.

It is, however, a mistaken notion, that the Korean people refuse to progress in any direction whatever. As in China, they are ready and glad to avail themselves of foreign manufacture where it will save expense. Their desire for progress is not based on sentiment but utilitarianism. Thus, while obstinately refusing to get his hair cut, the Korean gladly welcomes a good railway from Seoul to the port, a distance of twenty-six miles, which reduces the cost of passage and freight to one-fourth its former figure.

Another work worthy of attention, and the first undertaken mainly for the benefit of the common people, is the building of an aqueduct to supply the capital with a clean and wholesome water-supply, which will be obtained at a point some seven miles above the city from the Hans river, which is essentially a mountain stream, and in such quantity that a bath will no longer be a monthly, but a weekly or even a daily, luxury.

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Korea has just been deprived by death of Yi Chai Yun, the one man who has done most to bring about beneficial changes. For many years Mayor of Seoul, he has held his position through all sorts of vicissitudes, seen the rise and fall of cabinets, and remained immovable in the kaleidoscope of Korean officialdom. His term of office has seen the commencement and completion of the Seoul-Chemulpho Railway, the successful inauguration in the capital of a system of electric trolleys and the installation of an electric light plant, the widening and improving of its principal streets, and now this system of waterworks. This period, likewise, has been noted for persistent and successful attempts to raise the standard of education. Separate schools for the teaching of the various languages have been in successful operation, while the native schools have been greatly improved by the introduction of mathematics, geography, and universal history. Military matters receive increased attention, and the people are taught to believe that the soldier's career does not involve a loss of caste. A military school, housed in substantial foreign buildings, flourishes in Seoul.

To the above great improvements may be added the opening of five new ports to international commerce, and the development of the gold resources by three powerful syndicates—English, German, and American. A great deal still remains to be done. The rich coal-beds of the peninsula are waiting to be opened up, other minerals are ready for the scientific prospector, and it is proved that Korea could do more towards feeding her neighbours. Although it would be too much to say that no retrogressions have occurred during the last few years; although there have been retreats from positions taken up hastily in the progressive fever which immediately followed the Chino-Japan War—positions too advanced to be tenable; the recent progress goes far to prove that Korea is following with considerable rapidity, though on practical lines, her Japanese model.

The Cultivation of Gutta in the Dutch East Indies.—The increasing demand for gutta-percha, which is the leading product of Java and several other neighbouring Dutch East Indies—a demand which is expected to grow greater when the various cable schemes now in hand have been carried out—has called attention to the cultivation of the plant. Gutta trees growing wild cannot meet the coming demand, which must soon outrun the supply unless plantations on an extensive scale are laid out. Gutta leaves have been called into use in order to fill up the market supply, and the extract has consequently become an important branch of industry, a company called the Borneo Gutta Percha Company, with a capital of 500,000 guilders, having been formed at Batavia for its development. This company proposes to buy up a gutta factory at Miliouw on the Kapuar River, in West Netherlands, Borneo, where the gutta is extracted from fresh leaves by a French process.

Korean Railways.—French engineers have secured the contract for the Seoul-Wiju railway in Korea, which will shortly be proceeded with.

AFRICA.

Development of West Africa.—Sir Frederick Hodgson, Governor of the Gold Coast, in a speech to the London Chamber of Commerce, stated several interesting facts regarding the progress made in the successful development of the Colony. The trade of the colony had increased from less than £200,000 in 1889, the year after he had assumed the Governorship, to upwards of £2,000,000 in 1899, the revenue swelling in the same period from £97,000 to £354,000. Regarding the

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recent uprising in Ashanti, he said that the railway to Kumasi which was contemplated would be an important factor in the future. The railway was nearing completion as far as Tarkwa, which was situated forty-six miles from the coast. Although it was expected that the entire line would have been completed by the close of the year, he thought it now improbable that it would have proceeded beyond Tarkwa. He expressed his opinion that the Gold Coast would in the future be known as one of the largest gold-producing countries in the world, and opposed the proposition that the rubber industry was dying out because the natives did not know how to collect it, and destroyed the trees and rubber vines. Many trees and vines had been destroyed, but the industry was not on that account expiring. The Government were making strenuous efforts to protect it. They had enlisted the cordial sympathy of the native kings and chiefs, who had, at the Government's bidding, cleared large tracts of tribal land, and planted rubber-trees under the personal supervision of the Curator of the Botanical Gardens.

The Uganda Railway.—A telegram from Nyrobi, the headquarters of the Uganda line, states that the railway had advanced into mile 452 on October 30th while advance gangs were working up to mile 490. Ten miles or so beyond this is the disturbed area, as here the Nandi people approach and cross the line of route, although no mention is made of the work having been interfered with by the Wanandi. The recent news of fighting, in October 13, was probably taken by runners from Fort Ternan, in the Nandi country, to a branch telegraphic line from the railway to Eldoma Ravine, and from there transmitted to the coast.

A later telegram states that no anxiety need now be felt regarding the situation in Nandi. A large force controls the district, the railway and telegraph are now quite safe for transit; the Wanandi are suing for peace, and a satisfactory settlement is being arrived at.

West African Railway Development.—The colonies in West Africa appear to be developing very rapidly. On the Gold Coast the Sellondi-Tarkwa Railway is to be extended to Kumasi. It will serve an auriferous country, and will be guaranteed by several of the gold-mining companies chiefly benefited. It will be 180 miles long, with a gauge of 3 ft. 6 in., and will proceed through a dense tropical forest, which constitutes a very difficult route. Beyond Tarkwa the country is very much broken. At Lagos the three steel bridges, which connect it with the mainland, are finished, and the railway, which is 126 miles long, with a gauge of 3 ft. 6 in., is about to be opened to Ibadan—connecting Lagos, Abeokuta, and Ibadan, with respective populations of 60,000, 150,000, and 180,000. An extension to Ogbomisho, Ilorin, and the Niger is under consideration. Among bridges, there is the Carter bridge (2000 ft.), the Denton bridge (900 ft.); while there are eleven principal stations, with a number of minor ones. At Sierra Leone, a further section of railway has been opened as far as Rotifunk, and the extension of 80 miles to Bo has been begun.

AMERICA.

The Argentine Republic.—The section of the country most seriously affected by the recent inundation comprises 5000 square miles south of Buenos Ayres, where the traffic on the Great Southern Railway has been maintained with difficulty. The severe manner in which the permanent way has suffered is due to a policy of economy followed by the bad administration of recent years, which resulted in insufficient ballasting for the road-beds. There will, consequently, be heavy

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additional expenses in order to place the permanent way on a satisfactory footing. Preparations for this work are now proceeding. Heavy losses in live stock were experienced through the inundated districts, but the injury done to agriculture in the province of Buenos Ayres is not so serious as was supposed, while the harvest prospects in the wheat centre of Santa Fé and Cordoba are most promising.

Development of Agriculture in Uruguay.—Statistics, for the first time, have been issued, of the cereal productions of the Republic for the season 1899-1900. Wheat naturally stands first. Of 377,988 hectares under cultivation, on which 22,231½ metric tons (1000 kilogrammes) were sown, 187,553 metric tons were produced, or an average of 496 kilogrammes per hectare. Fully one half of this was raised in the two southern counties of Colonia and San José, which constitute the best wheat-producing districts in South America. The fertility of the soil varies greatly, and for some reason it is not the most fertile districts that are most extensively cultivated. The yield of other grains, which are cultivated only in small areas in few districts, is small, consisting of 33 metric tons of oats, 425 of barley, 519 of birdseed, and 1009 of linseed. Maize, the most important cereal product after wheat, has not been included in the returns.

There is considerable scope for further development in agriculture on a large scale and on scientific principles, and the present Government is taking practical steps to improve the means of transit in the interior, thus bringing its products to market with greater rapidity. Agricultural methods are still very primitive: and many landowners object either to cultivate their lands themselves, or to allow others to do so. Cattle-raising has been the traditional industry of the country, and the inhabitants with difficulty adopt any other, though this antiquated idea is dying out. In other directions, also, the country has great agricultural capabilities awaiting development. Grapes of a superb quality grow abundantly in many districts; the native wine compares favourably with the imported French, Spanish, and Italian; and large vineyards have been established. Although for several past seasons there have been outbreaks of phylloxera,—in endeavouring to combat which, the Government have introduced American vines, which are supposed to be impervious,—together with plagues of insects, the difficulties—with the exception of the locust, an occasional visitor—are being overcome. The wine industry has an important future before it, the population of Latin origin, drinking more wine than beer.

Figs and olives grow in profusion; peaches, apricots, and melons being especially abundant, together with all kinds of sub-tropical plants. It only requires a little enterprise, labour, and scientific cultivation, in order to establish some important industries in this direction, not only for home consumption, but also for exportation in the form of preserves. It is a lamentable example of lack of enterprise that during the season more fruit is grown than can be consumed, yet in the winter months the same fruit is sold in the preserved form, imported from Argentine and Chili. Tobacco, flax, and cotton have been cultivated as an experiment, with results which encourage efforts in a larger scale, while sugar-cane and castor-oil plants are regarded as possibilities of the future.

Yerba-Mate Cultivation in Paraguay.—A company, recently organised at Asuncion for the purpose of cultivating Yerba-mate, is expected to start planting immediately. Hitherto the yerba has all been taken from the Yerbales, and this is the first attempt at its cultivation on a large scale. It promises to become a paying industry, as the consumption of this tea in the River Plata countries is enormous.

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New Mail Service to the West Indies.—The first of the new line of steamers, which, under a subsidy of £40,000 from the British Government, is to assist in the development of the West Indian Colonies, was launched on November 8 from the shipbuilding yard of Sir Raylton Dixon and Company on the Tees. The vessel is one of four which are being built to the order of Messrs. Elder, Dempster, and Company, Ltd., for the purpose of constituting a regular fortnightly service between Jamaica and Bristol, which will carry bananas and other fruits for European consumption, together with passengers and mails. The vessels are being built to the following dimensions, viz.—388 feet long, 46½ feet beam, and 32 feet 7½ inches moulded depth. The passenger accommodation is of the most luxuriant description, and allows for one hundred first-class and fifty second-class passengers. With the Government subsidy, the Company has undertaken to encourage and aid good hotel accommodation in the islands, provide the mail steamers necessary to make the voyage in ten days, skilled agents to improve the Jamaica fruit cultivation, and to purchase to the extent of 20,000 bunches of bananas to be shipped every fortnight. The contract—a ten years' one—provides for the building and running of much larger steamers by the beginning of 1904. The new line begins to run on January next.

Cession of Spanish Islands in Oceania.—A convention between Spain and the United States was signed in Washington on November 7th, in which Spain cede to America the islands of Cagayan and Sibitu—her sole remaining possessions i Oceania—receiving in payment the sum of £20,000.

NEW BOOKS.

Lehrbuch der Geographie, von HERMANN WAGNER. Sechste, gänzlich umgearbeitete Auflage von Guthe-Wagner's "Lehrbuch der Geographie." Erster Band—Erschienen in 4 Lieferungen, 1894-1899—Einleitung. Allgemeine Erdkunde. Hannover und Leipzig. Hahn'sche Buchhandlungen, 1900. Pp. xvi + 882.

It is a German custom to term what is practically a new book a new edition of an old one by the same author, if the new work is on similar lines to the old one. This volume is essentially a new work, and a very welcome one. For the first time we have a modern account of General Geography (*Allgemeine Erdkunde*) dealing with all its parts in a systematic and proportionate manner. The plan of the book is as instructive as the details of each section, and both deserve the close attention of student and teacher.

The introductory chapter gives a concise guide to the literature of geography to about 1894, when this part of the book was first published; a brief history of geographical ideas, which shows the continuity of the fundamental plan of the science since ancient times, and its gradual extension; and a discussion of the signification and subdivisions of geography, which is at once a natural science, dealing with the distribution of natural objects and phenomena on the Earth's surface, and a link between natural science and history, dealing with the distribution of man and his activities, and discussing the dependence of man on nature, and what he has been able to do to overcome it.

Professor Wagner adopts a fourfold division into Mathematical, Physical, Biological, and Anthropological geography, according as each of these sciences

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comes most into consideration. We regret that he should have lent his great authority to perpetuating the term Mathematical Geography for the discussion of the Earth as a whole, plus an account of cartography. The latter is not an essential division of geography any more than is a study of the conventions of engraving. Cartography is, however, an indispensable aid to the geographer, and must find its place in a text-book of geography, but in an independent section dealing with methods of representing geographical data. For the former, which is part of physical geography, the term Mathematical Geography is too wide. Mathematics can be applied to the treatment of any part of geography, where the data are in themselves sufficiently simple to be expressed in mathematical notations, or can be made so by neglecting the less important ones. In geography, as in most other concrete sciences, mathematical notations give concise and precise ways of expressing first or closer approximations to truth, from which most valuable deductions can usually be made by means of mathematical operations. It is too often forgotten, however, that these deductions, while mathematically strictly accurate, are concretely of the same order of approximation to truth as the data on which they are based. Remembering this, it is a great gain to give mathematical expression to, just as it is to express diagrammatically, any series of facts of any section of geography.

Physical geography is discussed in four chapters—the surface of the Earth, the dry land, the ocean, the atmosphere.

Biological geography is divided into five sections, the biosphere, the distribution of organisms, general results of wandering and transformation, land vegetation, useable plants and animals.

The fourth division, Anthropogeography, is so inadequately treated in all English books, that it may be well to give a full list of its contents :—

I. *Man.*—Age of, the oekymene, numbers.

II. *Natural Divisions of Man.*—Unity of mankind, relationships among men, races and ethnological groups, chief bodily distinctions among men, speech distinctions, races of men, the threefold division, adaptations of races and peoples to climate, food in different climes.

III. *Culture Divisions of Man.*—Stages of civilisation, economic associations, natural people and their distribution, the extinction of natural peoples, distribution of materials of civilisation, civilisation groups and areas, semi-civilised and fully civilised, nomads and their distribution, economic stages of settled civilised people.

IV. *States (Political Geography).*—Taking possession of the land by man, political organisation of states, fundamental distinguishing peculiarities of states (*Staatsgrundmacht*), great divisions of states, world and colonial states, great states, middle states, minor states, political space, geographical and political position, growth and form of the political area, metropolitan region and centre (*Kerngebiet, Kernstadt*), sea powers, political boundaries, regional divisions and frontier development, inner division of state, parishes and local districts (*Gemeinden u. Heimatsbezirke*), counties and provinces (*Gaue u. Landschaften*), adjacent protectorates and colonial territory (*Nebenländer u. Kolonialbesitz*), boundaries of external possessions and spheres of influence, types of external possessions, development of present colonial territories, present conditions.

V. *Religious Groupings and their Distribution.*—Religious areas, heathen religions, religions of civilised and semi-civilised Asiatics, Islam, Judaeism and Christianity, Christian missions, general sketch.

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VI. *Settlements and Density of Population.*—Human settlements (*Ansiedelung*), topographical form of settlements (*Wohnplatz*), variable and transitory settlements, single settlements (*Kleinsiedelungen, e.g.* farm), villages, topographical and transport position of settlement, types of town sites, environmental control, occupations, surface conditions and position, prevailing occupations, occupation classification of town and country, classification of settlements by population, growth of towns, physiognomy and environs of towns, settlements on maps, density of population and settlements, varieties of population maps, typical degrees of density, regional distribution of man on the Earth's surface, vertical distribution of men, great cities.

VII. *Routes and Means of Transport.*—Routes and traffic, helps and hindrances, the road in relationship to means and style of transport, regional distribution of diverse types of roads and means of transport, footways and transport by porters, bridle-paths and transport by pack animals, roads and transport by sledge or wagon, inland shipping, inland canals, railways, sea routes, sailing ships and their routes, steamers and their routes, interoceanic canals, routes on the map, the conquest of space and isochronic maps.

VIII. *International Traffic and Trade.*—Development of world traffic, international trade in ancient and mediæval times, in recent times, to-day, trade statistics, commodities of international trade, present granaries of the world, coal and iron, noble metals, international posts and telegraphs.

From this outline of the contents of Professor Wagner's work, it will be seen that the geographical point of view is adopted throughout. Many books on physical geography use the physicist's or the geologist's classification and treatment, and nearly all works on the distribution of organisms those of the biomorphologist. The change to the geographical treatment is a great gain to the geographer. It permits comparisons of different distributions, and gives a unity to the work which so many books on geography lack. It emphasises the fact that there is a science of geography, which is much more than a collection of extracts from the rudiments of other sciences, and is a necessary, consistent, and complete interpretation of knowledge from a particular point of view. If, here and there, Professor Wagner has introduced a section which is not precisely geographical, it is a preliminary to a geographical one, and necessary in present conditions when it is not safe to assume a knowledge of it on the part of the reader.

The book is also a compendium of the best statistical material at present available, on which the author is our greatest authority. In bibliographical matters it is equally critical and on the whole complete. Bibliographical notes are prefixed to each section. The short summaries tracing the development of the scientific ideas discussed in each section are admirably compendious and lucid.

Professor Wagner's work is a masterly academic presentation of the principles of geography, full, learned, critical, and a model of clear exposition.—A. J. H.

La Traversée de l'Afrique du Zambèze au Congo Français. Par EDOUARD FOÁ. Paris: Librairie Plon. Pp. xii + 323.

Under this title M. Foá, one of the best known of the French explorers of Africa, has published the account of his last journey—that from the mouth of the Zambesi to the mouth of the Congo. In this book he gives a full description of an

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exceptionally hard journey which has been of considerable scientific value. The natural history collection comprised 60 mammals, 160 birds, and a great number of fishes and insects. Of these a zebra, a monkey, some insects, and a few fishes being new to science, have been named after their discoverer. Eight hundred astronomical observations with sextant and theodolite were made during the journey, while the geology, ethnology, and to some extent the folklore, of the districts traversed were studied. M. Foá gives interesting details of the different tribes he visited, their manners, customs, costumes, and occupations.

In speaking of the district to the west of Nyasa, M. Foá makes a statement which will be read with some interest in this country. He asserts that the chief Jumbe, having made submission to H.M. Commissioner for British Central Africa and professing to have given up slave-trading, hoodwinked the Administration by sending his slaves westwards to the borders of Mwasi's country, where they were picked up by Arab caravans, instead of, as formerly, shipping them in dhows across the Lake. M. Foá says that the efforts of the British to put down slavery have simply resulted in the slave-trading chiefs changing their caravan routes throughout the territory under our influence; and, admitting our desire to put a stop to slavery, he casts ridicule on the Blue Book accounts of the work done and the results attained, saying that "they (the British) deceive themselves and deceive us when they pretend to have arrested it."

M. Foá says that of all European nations the British is that which dislikes the Black most. If the fact that as a race we do not lower ourselves socially to the level of the natives, as do other white peoples, is an argument in favour of this, he is certainly correct. On the other hand the Portuguese, who practise social equality most, are those who receive least respect—so much so that in Portuguese territory a traveller is unable to get labour except by payment beforehand.

The author makes a curious mistake in supposing the mythical "Mountains of the Moon" to have been south of Lake Tanganyika, whereas on the old maps they are marked as being to the south of Abyssinia.

Some exciting incidents are recorded, as when, to the west of Tanganyika, the party had to flee hurriedly from the country of Cherif pursued by five hundred men. This is a large number.

The account of the journey from Lake Tanganyika to the French Congo is the most interesting part of the book. That district being less known, considerable new information is given. M. Foá's remarks on the pygmy races with whom he came in contact will be of great interest to all who study ethnology.

While not above criticism, M. Foá's book is full of interest throughout. No one is more competent to speak upon the manners and customs of the tribes among whom he has lived than its author.

The plates, some of which are of special value, are numerous and good.

Since the publication of this book M. Foá has, for the excellent work he has done on this and other expeditions, been presented with the Great Gold Medal of the Geographical Society of Paris, and has been made a member of the "Legion d'Honneur" by the French Government.

Eaglehawk and Crow: A Study of the Australian Aborigines. By JOHN MATHEW, M.A., B.D. London: David Nutt; and Melbourne: Melville, Mullen, and Slade, 1899. With Illustrations and a Linguistic Map. Pp. xvi. and 288. *Price* 18*s. net.*

The title of this work is explained by the author thus. The aborigines (so-called) of Australia present dissimilarities of language, of custom, and of

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physical type, which suggest that they are really a blend of two or three separate races. Tradition and myth seem to indicate that, at any rate, two opposite races are vaguely shadowed forth in tales relating to the differences between "eaglehawks" and "crows," by which terms we are to understand the totems of these two main divisions; that, in short, "the eaglehawk and the crow represent two distinct races of men which once contested for the possession of Australia, the taller, more powerful, and more fierce 'eaglehawk' race overcoming and in places exterminating the weaker, more scantily equipped, sable 'crows.'" This hypothesis the author supports by an array of evidence drawn from many sides. It may be added, that these "eaglehawks" and "crows" seem to have had their final struggle in the territory now known as Victoria.

The author's general conclusions are as follows:—"Australia was first occupied by a people, a branch of the Papuan family, and closely related to the Negroes. They came from the north, in all likelihood from New Guinea." "It is not affirmed that they were purely Papuan; the Negrito (black dwarf) and the Melanesian may both have been represented and fused together. . . . I incline to that opinion" (pp. 5-6 and 61). To these succeeded an immigration of Dravidians, or, rather, of a people akin to the Dravidians of Southern and Central India, who overcame the earlier inhabitants, and to a great extent incorporated them with their own stock. Later still, this compound people was distinctly affected, although in a more intermittent fashion and with less emphatic results, by colonies of Malays settling in the island-continent at various periods, all anterior to the epoch of British colonisation. Untouched by the successive incursions of the Dravidian and Malayan peoples, the recently extinct Tasmanians were the modern representatives of the earliest Australian stock. Such, briefly, are Mr. Mathew's deductions; and very interesting and attractive they are.

Of course, assuming that this is the correct pedigree of the Australian blackfellow, it is obvious that it may be carried a step further back. If the supposed substratum was a blend of Melanesian and Negrito, as Mr. Mathew is inclined to think, the question arises: Did these two stocks become fused prior to their arrival in Australia? If not, then one or other of these must have been the actual aboriginal race.

One curious inconsistency, in an otherwise well-balanced work, is the statement (p. 23) that the boomerang was unknown among the Tasmanians, whereas in the picture which forms the frontispiece to the book [a group of Tasmanian aborigines, photographed from Mr. Dowling's painting of 1860, in the Public Library at Launceston] the two East Coast natives, painted from life, are represented as holding boomerangs. In agreement with this picture are the accounts given in Rowcroft's *Tales of the Colonies*, published about sixty years ago. These "Tales" of Tasmanian life in the early part of this century do not profess to be actual history, but the author states in his introduction that he "can testify to the accuracy of the descriptions which they contain, from his personal experience as a resident magistrate in the colony." In this realistic novel, therefore, the Tasmanian natives of about the year 1830 are described as using the boomerang, invariably called the "womera" (wūmera) by Mr. Rowcroft, a term which suggests itself as a variant of the more familiar "boomerang." Possibly Mr. Rowcroft's further statement (vol. ii., edition 1843, p. 36) that it is "a scarce weapon among them, and much prized," may account for its very existence having been forgotten in later years.

That, however, is only a trifling inaccuracy in a most valuable book. Every chapter, whether relating to the language, the customs, or the ethnography of the natives, bears witness to Mr. Mathew's intimate knowledge of his subject, the

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accretion of years of personal observation and of a wide survey of cognate literature.

Origin and Character of the British People. By NOTTIDGE CHARLES MACNAMARA. London: Smith, Elder, and Co. 1900. Pp. 234. With 33 Illustrations. *Price 6s.*

Mr. N. C. Macnamara, F.R.C.S., has done considerable service in writing this most useful as well as interesting book to show how the science of anthropology, which most people consider dry, is very interesting and can be turned to practical account. He shows us how and why the natives of the south and west of Ireland, as also those of the greater part of Wales, differ as regards their character both from Englishmen and Scotsmen. This difference is explained and traced to its source in a graphic and instructive manner.

We have not space to refer to the first three chapters of his book, on palæolithic man; the Iberian and Aryan prehistoric people of Western Europe; the ancient brachycephalic (broad-skulled) or Mongolian people of Europe.

Chapter IV. deals with the racial origin of the population of the British Islands, and in this the author gives, in broad outlines, with a firm touch, a rapid description of prehistoric man, and then refers to the invasions and migrations which took place from Europe, and shows how they influenced the various mixed races in our countries. Chapter V. is a most interesting account of the development of man's intellectual faculties together with the psychological characteristics of the progenitors of the English people, and concludes with some remarks on the effects of residence in cities upon the racial qualities of individuals. His brief summary of the Iberians, Mongolians, Teutons, or Aryans is exceedingly good, and his remarks on the effects of the mixture of these great races is admirable. He refers to two practical points here,—first, with regard to the future of South Africa, showing that if matters are looked at from an anthropological point of view, a mixture of the races will take place, and that the Boers should become as valuable to the Empire as the Aryans in India (the Sikhs). With regard to the effect of large towns on people, it produces excitable and nervous individuals when called upon to exercise their sole judgment, and opines that they are wanting in self-reliance and in those solid and lasting qualities which characterise their country-bred brethren. In this connection he instances that the police of London are all obtained from the provinces, but he shows that boys taken from London and put into the Navy do well owing to strict discipline and concerted action. The nervous bias is only produced after three generations of residence in a city. We cannot conclude better than by quoting his final paragraph:—"Our desire has been to give a practical turn to anthropological research, believing that it is wise to gain as sound a scientific knowledge as possible regarding man and of his relation, not only to the present, but also to future generations."

La Rénovation de l'Asie. Par PIERRE LEROY-BEAULIEU. Armand Colin et Cie, Editeurs. Paris, 5. Rue de Mézières, 1900.

In this volume we have to remember that by the term Asia the author means merely Siberia, China, and Japan, and by renovation he means certain factors now at work in these countries, on account of which he anticipates that their present condition will be much changed and their future much modified. In the case of Siberia, the principal, if not the only, leaven which is to regenerate the huge territory, is the Trans-Siberian Railway, the completion of which may be expected in a few years. Leading up to this we have a fairly interesting sketch

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of the country and its inhabitants, productions, commerce, etc., which may contain matters fresh and new to French readers, but all of which have repeatedly been put before the English public by writers like Mr. Harry de Windt. It may also be doubted if the completion of the railway will necessarily entail all the results which Monsieur Leroy-Beaulieu predicts. As to Japan, its renovation is admittedly being worked from within and not from without, by the Japanese themselves and not by foreigners. The author lays just weight on the absence of ultra-conservatism among the Japanese, and their readiness to adopt what takes their fancy among the customs and institutions of other, and more especially western, nations. He enlarges on the astounding, though recent, development of their naval and military power, and of their commerce and finance. None of his facts or views have any claim to originality, but they are put clearly and tersely, and are worth a perusal as showing how the Japanese question is regarded by a well-informed Frenchman.

With regard to China, the author seems to hold the very general opinion that sooner or later the Celestial Empire will be partitioned among the great European powers and Japan. In fact, the partition may be said to have begun already under the euphemism of the establishment of "separate spheres of influence," and it would proceed much more rapidly were it not for the mutual jealousies and distrusts of the powers. It is very clear also that the author thinks France has not got, and is not likely to get, her fair share of the spoil, and that what she has already got is not much worth.

Narrative of Cruises in the Mediterranean during the Greek War of Independence, 1822-26. By WILLIAM BLACK, L.R.C.S.E., Surgeon H.M.S. *Chanticleer*. Edinburgh: Oliver and Boyd; London: Simpkin, Marshall, and Co., Limited, 1900. *Price* 14*s*.

The editor of this volume explains in the preface that the idea of publishing his uncle's journal occurred to him because of the last Turco-Greek war about the independence of Crete, which may now be considered almost ancient history. The journal describes visits to various ports in the Mediterranean between 1822 and 1826, when the Greeks were waging the war against the Turks which has been immortalised by Lord Byron. It seems pretty obvious that the surgeon of the *Chanticleer* had not very much to do, and, having a keen eye for the picturesque, he kept a diary in which he recorded his impressions. It has to be confessed that his language is often dreadfully stilted and ponderous. When he wishes to say that they lost sight of land at sunset, he puts it thus:—"Like the fleeting images of the night, the prospect was soon lost, and before our approach was near enough to call up our interest, or leave any lasting impression, we were again wafted to sea, and ere Apollo's fiery track was extinguished in the west, our barque had stolen far from the land, not a vestige of which remained visible in the wide scope of the briny horizon." In a calm they saw a turtle; whereupon "a boat was soon lowered, and after a few sweeps of the oar, the poor captive was brought on board, where soon were attracted round it both the eyes of the curious and the *bon vivant*, each interested in their respective gratifications. To fill up the time, now fully and scientifically were discussed every arcana of the culinary art, and the joys of to-morrow's feast took precedence of every other anticipation. I may add instead of the old saw a new one, 'It is no wind which brings a body good'; for although such a frequency of calms was annoying to the passenger, and productive of growling *ennui* to the seaman, yet, with a favourable breeze, their tables could never have been graced with such dainties as those, in which

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a considerable number participated: for, in the course of the afternoon, five excellent fish were taken, which served to divert for a little the energies of all from navigation to gastronomy." It must be admitted that a little of this goes a long way. He was a spectator of some actions between the Greek and the Turkish fleets, and his accounts of them read strangely when we remember the actions fought lately between the American and Spanish fleets. *Tempora mutantur.*

British America. ("The British Empire Series.") London: Kegan Paul, Trench, Trübner and Co., Limited, Paternoster House, Charing Cross Road, 1900.

In the issue of this Magazine for February last we noticed the second volume of the "British Empire Series." The third volume, which is now before us, is constructed on the same system as its predecessor, and consists of a number of essays originally delivered as lectures between 1895 and 1898, which have now been connected, and here and there extended and brought up to date. The mere mention of the names of those to whom the task of describing British America was confided is sufficient to inspire confidence in the reader that the subject is adequately dealt with. Lord Strathcona and Mount Royal, Professor Sheldon, Messrs. Duff, Millar, and Coryn, Sir J. G. Bourinot, Sir Augustus Adderley, Sir William Robinson, Dr. Emil Reich, are names too well known in connection with British America to need recommendation from us. Obviously the most formidable difficulty with each writer has been to condense what he knew and had to say about the part of British America which had been intrusted to him, and yet to do justice to his subject. As a rule the writers endeavour to steer clear of present politics, but several of them insist with much force on the necessity of the Imperial Government taking measures of some kind or other to save the sugar industry from total destruction, as the result of the bounty system in France. But the tendency of the essays is decidedly optimistic and to make the best of everything, and to paint in rosy hues the life and prospects of an emigrant wheresoever he may choose to settle in British America. As a concise and faithful description of the present condition of our American colonies this volume may be recommended to all who are thinking of emigration, and weighing the advantages and disadvantages of one particular colony against those of another.

Bilder aus dem Kaukasus. Neue Studien zur Kenntnis Kaukasiens. Von C. von Hahn, Professor am I. Gymnasium zu Tiflis. Leipzig: Dunckler und Humbolt, 1900. Pp. 335. *Price* 6 *M.*

This is the third book which Professor von Hahn has published on the Caucasus. During twenty-five years he has given up all his leisure hours to a study of the country and its people, their manners and customs. He seeks to give "snapshots" with all the lights and shadows, so as to preserve the present-day conditions for the instruction of future generations.

He knows well how rapid are the changes which political and social movements bring upon a people, especially when the population is of so varied a nature as it is in the Caucasus.

The total population is some 9,248,000, in an area of 8500 square miles; the density of the population varies from thirty to the square kilometre near Kutais, to some eleven to the square kilometre near Kars.

This very interesting book is more anthropological than geographical; it deals with the people's daily life, their customs and beliefs, religions and superstitions, laws and traditions.

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Professor von Hahn has provided us with a vivid series of pictures illustrating all these points, and all those who study the Caucasus, and even those who are simply interested in the East, will do well to read this book, which we can assure them they will do with much pleasure and profit.

Surveying and Exploring in Siam. By JAMES MCCARTHY, F.R.G.S., Director-General of the Siamese Government Surveys. London: John Murray, 1900. Pp. xii + 215. *Price* 10*s.* 6*d. net.*

Mr. McCarthy was employed for twelve years in organising the Siamese Government Survey Department, and "in collecting material for the compilation of a map of Siam which might form the foundation of a national survey system." The feature of his present book, therefore, is its map, which has been engraved on copper at the expense of the Siamese Government, and under the auspices of the Royal Geographical Society. Produced on a considerable scale in two portions—one representing Northern Siam and the other the Malay Peninsula—this map contains much clearly expressed information, a considerable portion of which has been collected by Mr. McCarthy and his assistants. Upper Siam, in which the Department has been most active, and also those provinces of the Malay Peninsula which form an integral part of the Siamese kingdom, are represented in considerable detail; but many little inaccuracies can be detected in the portrayal of the Malay States. It is a pity that the Malay names have not been transcribed with greater care, but the glossary of Siamese and Malay geographical terms is useful. The book also contains a triangulation chart from the Indian Triangulation Frontier series. With regard to the letterpress, its author modestly refers to it as "the following notes." It casts light on the people, and especially on the topography of Siam—a country of which we know as little as of any other of its civilisation and progress. Nevertheless, although the art of rejection is as praiseworthy as it is rare, we cannot but complain of the shortness of Mr. McCarthy's book, and hope that it is only the preliminary study for a more extensive work. In nineteen years the author must have gathered, even in the form of notes, far more interesting and valuable information than could possibly be compressed into 196 pages. The illustrations are numerous, but unfortunately the majority of them are poor, and many are from photographs that have been seriously affected by climate and the accidents of travel. The Index is copious and thorough.

The Value of the Waters of the Great Rivers of India.
By Major-General F. C. COTTON.

In this paper, reprinted from *Blackwood's Magazine* for May 1900, and also in a continuation on the "National Importance of employing that Water for the Prevention of Famine," etc., Major-General F. C. Cotton, C.S.I., argues against that policy which permits floods of water in India to empty themselves into the sea, while the land and the people it feeds are dying of thirst, and endeavours to show by contrasts between irrigated and unirrigated districts in India and the countries of the world, that water is the blood of the earth, and that countries thickly veined with canals, and nerved by railways—America shown forth as an example—constitute types of prosperity.

Die Insel Giglio. Prague: Heinr. Mercy Sohn, 1900. Folio. Pp. 127.

We are again indebted to his Imperial Highness the Grand Duke Ludwig Salvator for a splendid geographical monograph, containing illustrations after his own admirably realistic sketches, and a description, in his own partly scientific,

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partly picturesque manner, of the Island of Giglio, which he informs us "furnishes Rome with the greatest proportion of its plaster, and serves as a sea-bathing resort for the Romans and Florentines. The girls of Giglio go as domestic servants to Rome; its men fish all the surrounding coasts. It may be called a suburb of Leghorn." He adds, "The inhabitants of Giglio are a magnificent race. The expression of the girls' faces is so soft and mild that they seem to be models for Old Italian masters, whilst their complexions are so fresh and healthy that it is a pleasure to look on them. . . . The men are so frank and natural that we must conclude that they spend their lives happily upon their granite island."

Nelson's Supplementary Reader—The Story of the North-West and North-East Passages. By C. G. CASH, F.R.S.G.S. London, Edinburgh, and New York: Thomas Nelson and Sons, 1899.

Two little books constituting simplified extracts from contemporary accounts of the early attempts to discover the North-Western and North-Eastern Passages. Admirable for young people.

La Spéléologie ou Science des Cavernes. Par E. A. MARTEL (*Scientia*, Mars 1900). Paris: G. Carré et C. Naud. Pp. 126. *Price* 2 *frcs.*

The author commences this admirable little treatise by distinguishing between Spéléologie and Spéologie, the latter relating to *artificial* excavations such as the tombs and sanctuaries of Egypt. As a masterly account of the physical agencies which created caverns, this treatise may be warmly recommended; but among British Speleologists we miss in it reference to the late William Pengelly, F.R.S., whose researches in Kent's Cavern, Torquay, had such remarkable results and represented his incessant labour from 1865 to 1875.

Dent's County Guides.—I. Hampshire with the Isle of Wight. By GEORGE A. B. DEWAR, JOHN VAUGHAN, and others. *II. Norfolk.* By WILLIAM A. DUFF. London: J. M. Dent and Co., 1900. *Price* 4*s.* 6*d. net each.*

These guides may be said to inaugurate a new departure. Instead of the bare statistics, dry details, and unattractive forms of customary guide-books, we have here dainty little volumes with interesting letterpress, clear maps, and exquisite woodcuts from original sketches. For a ramble through Hampshire, the Isle of Wight, or Norfolk, no lover of the beautiful could have more delightful companions. The scenery of the Isle of Wight inspired both George Morland and Alfred Tennyson, and Mr. Vaughan might perhaps have made more of such famous visitors. Good maps by Bartholomew of Hampshire and the Isle of Wight and of Norfolk are given in slip-cases in the respective volumes.

Sir Stamford Raffles. England in the Far East. By HUGH E. EGERTON, M.A. ("Builders of Greater Britain" Series.) London: T. Fisher Unwin, 1900. Pp. 290. *Price* 5*s.*

Mr. Egerton declares that to Sir Stamford Raffles, "more than to politicians or treaties, Great Britain owes her position in the Far East." Having examined the Records in the India Office, including papers still in the Surat Department, Sir Stamford's letters home, besides other reliable authorities, he has produced a work which succinctly yet effectively relates the life of a very remarkable man. The conquest and government of Java and the acquisition of Singapore form Raffles's chief claims to fame, whilst his administration of Bencoolen in Sumatra proved his skill in overcoming many obstacles. "Although Raffles," says the

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author, "was the only begetter and author of British Singapore, the actual time he spent there was very short." His complete success there rendered the question of Acheen (in Sumatra) of less importance, and Mr. Egerton observes, "When we remember that our Dutch friends have only recently secured predominance at Acheen, after a war which lasted over twenty years, we may rejoice that British interests did not thrust us into this hornet's nest."

Khaki in South Africa.

China of To-day: The Yellow Peril. London: George Newnes, Ltd., 1900. *Price 5s. each.*

These publications have been issued to illustrate recent events, and are published in the form of folio albums of photos (those of China are exclusively so) and sketches by well-known and celebrated artists. A short description is given at the foot of each picture. The volume on South Africa illustrates, as may be looked for, scenes of the war, while that of China depicts the country and people. For the most part the pictures are clear and good. The volumes are strongly and neatly bound, and would make suitable gift-books for either young or old.

How to read the War News from China. London: T. Fisher Unwin, 1900. Pp. 142. *Price 1s.*

A handy little book, containing information about the provinces, towns, peoples, and matters of general interest connected with the Celestial Empire, and which should be very useful with regard to present Eastern affairs. It is accompanied with a map, although not coloured as is stated in the title-page.

The Dominion of Canada: With Newfoundland and an Excursion to Alaska. Handbook for Travellers. By KARL BAEDEKER. Second revised edition. Leipzig: Karl Baedeker. 1900. Pp. lxii + 268. *Price M. 5.*

The names cited in the introduction as authorities are a sufficient guarantee that the work is thorough and accurate; the writer is Mr. J. F. Muirhead, M.A., author of the companion volume on the United States, who has personally visited the greater part of the districts described. The get-up of the book, which is well supplied with capital maps and plans, follows that of Baedeker's European guides. It should prove indispensable to the traveller in Canada.

NEW MAPS AND CHARTS.

EUROPE.

EUROPE, Stanford's New Orographical Map of ——. Compiled under the direction of H. J. Mackinder, M.A. *Edward Stanford, London.*

We are pleased to see this new wall-map of Europe. It is another sign of the progress of geography and geographical teaching in Britain. The map resembles some of Bartholomew's orographical maps both in design and colouring, but it is, as far as we know, the only wall map of its kind. It is pointed out that the scale is a "natural" one, each feature on the map being one four-millionth of its length on the ground; the towns are however not of this scale, and it is a question if for a wall-map a more diagrammatic representation of certain features is not better. A student in a classroom with ordinary good sight at a distance of more than twenty feet sees very little else than two shades of brown for the land and the Volga and Danube; and three shades of blue for the sea; he is unable to distinguish the

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outline between land and sea owing to the fineness of the coast-line and the similarity of colour of sea and land for depths and heights of 500 feet. The idea of having contours at the same intervals on the land and in the sea is good; but there is no doubt the fathom is less clumsy than the foot for the sea. A seaman always has the fathom-length with the outstretching of his arms; a fathom of water under his ship's keel is certainly the smallest unit he can count upon with safety for even the slowest navigation. Why not have the 600-foot contour on the land as the equivalent of the 100-fathom sea-line, and so forth? The map is, however, the best of its kind yet produced in this country, and we hope that other similar and improved maps may be forthcoming. We congratulate Messrs. Stanford and Mackinder on their enterprise. Some firms do not think of producing physical wall-maps at all, because it does not pay them to do so.

SCOTLAND.—CHARTS. Portree Harbour. No. 1839, August 1900. Island of Islay. No. 3116, May 1900. *Admiralty Office.*

ENGLAND AND WALES. The complete "Safety" Cycling Map. Scale 15 miles to 1 inch. *Gall and Inglis, Edinburgh.*

We think it would have been better to have left out some of the less important roads near the large towns; the scale does not admit of so many lines being shown clearly.

CHESHIRE. Bartholomew's Reduced Ordnance Survey. Scale 2 miles to 1 inch. Sheet 12. *Price on cloth, 2s.*

BELFAST AND N.E. COUNTIES. Bartholomew's Reduced Survey. Scale 4 miles to 1 inch. Sheet 2. *Price on cloth, 2s.*
John Bartholomew and Co., Edinburgh.

Orographically coloured, with roads, railways, and boundaries well marked.

IRELAND. W. and A. K. Johnston's Map of the Railway Systems. Size 34 × 28 inches, mounted on rollers. *W. and A. K. Johnston, Edinburgh.*

The railway lines, which are distinctly shown in colours, have been revised by the various companies. Coach and steamer routes and canals are indicated.

GERMANIA, Etc. Murray's Handy Classical Maps. Edited by G. B. Grundy, M.A. *Price 1s. net.* *John Murray, London.*

ASIA.

CHINA. W. and A. K. Johnston's map to illustrate the Chinese Question. *Paper, 1s.* *W. and A. K. Johnston, Edinburgh.*

CHINA, JAPAN, and KOREA. Stanford's Map of Eastern ——. Scale 110 miles to 1 inch, July 1900. *Stanford's Geog. Estabt., London.*

These maps are issued to illustrate the Chinese Question.

SOUTHERN CHINA. Map of ——. Scale 1 in. = 36 miles. No. 1743—1. August 1900. *Quartermaster-General's Dept. in India.*

PALESTINE, Etc. Murray's Handy Classical Maps. Edited by G. B. Grundy, M.A. *Price 1s. net.* *John Murray, London.*

AFRICA.

MOROCCO, ALGERIA, Etc. Stanford's map of Morocco, Algeria, Tunis, and parts of Tripoli, Senegal, and the Military Territories of the Western Sudan. Scale 1 : 5,977,382, or 94⅛ miles to 1 inch. June 1900.
Stanford's Geog. Estabt., London.

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This sheet is coloured politically and the boundaries and the routes of travellers are shown.

SOUTH AFRICA. Sketch Maps of the country round the following towns:—Komati Poort, Rustenburg, Bloemhoef, Heidleberg, Wakkerstroom, Vrede, Lydenburg, Ermelo. All on scale of 1 : 250,000, or 3·94 miles to 1 inch.
Intelligence Division, War Office (No. 1367).

AMERICA.

UNITED STATES. Relief Map. Contour Map. Base Map. *All reprinted Sep.* 1899.

Distribution of the Magnetic Declination in the United States in 1900. Compiled by Henry Gannett.

United States, compiled under the direction of Henry Gannett, Chief Topographer, by Harry King, Chief Draughtsman. Scale, 1 : 2,500,000. Approximately 40 miles to 1 inch. 1898. 3 Sheets.

New York City and Vicinity. Albany and Vicinity. Washington and Vicinity. Omaha and Vicinity. Contour interval 20 ft. Scale 1 : 62,500. Virginia—North Carolina. Topographic Sheets. Scale 1 : 125,000. Montana (Silver Bow Co.). Butte Special Map. Topographic Sheet. Scale 1 : 15,000. Contour interval 20 ft. Utah. Tintic Mining Map. Scale 1 : 9,600. Contour interval 20 ft.

UNITED STATES. Topographic Map of the Geological Survey.
(*The figures indicate the number of sheets received*).

Alabama (1); Arkansas (1); California (33); North Carolina (3); Colorado (11); Connecticut (1); Dakota, North and South (12); Georgia (4); Idaho (4); Illinois (2); Indian Territory (3); Iowa (1); Kansas (2); Kentucky (3); Louisiana (1); Maine (4); Maryland (8); Massachusetts (7); Michigan (4); Montana (1); Nebraska (13); New Hampshire (2); New Jersey (18); New Mexico (1); New York (49); Oregon (3); Pennsylvania (4); Rhode Island (1); Tennessee (3); Texas (6); Utah (1); Vermont (5); Virginia (11); Washington (3); Wisconsin (2); Wyoming (4).

TEXAS, and Parts of adjoining Territories. Compiled by and under the direction of Robert T. Hill. Scale 25 miles = 1 inch.
United States Geological Survey.

SOUTH AMERICA. Commercial Map of ——. By J. G. Bartholomew, F.R.G.S. Revised by John Samson, F.R.G.S., of the *South American Journal*.
The Edinr. Geographical Institute.

This is a new edition of a map which assuredly deserves high commendation.

NEW ATLASES.

EUROPE, Historical Atlas of Modern ——. From the decline of the Roman Empire. Edited by Reginald Lane Poole, M.A., Ph.D. Parts 26 and 27.
Clarendon Press, Oxford.

LONDON Philips' Handy Volume Atlas. Third Edition. 1900. *Price 5s.*
George Philip and Son, London and Liverpool.

This volume contains a series of fifty-five sectional maps (on a scale of three inches to the mile), twelve special maps showing the railways, geology, etc., plans, a directory of public buildings, etc., and a complete index. We noticed the first edition very favourably, and have only now to mention that, with one or two slight exceptions, the original plan has been adhered to.

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ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

REPORT OF COUNCIL.

SIXTEENTH SESSION, 1899-1900.

The Council has the honour to submit the following Report :—

MEMBERSHIP.

The changes in the number of members have been as follows :—

Number on 1st November 1899,		1592
New members added,		75
		1667
Deduct by Deaths,	44	
„ Resignations,	68	
Struck off the roll (subscriptions in arrear),	9	
		121
Number remaining on 31st October 1900,		1546

Of the present members, 900 are on the Edinburgh list, 288 are on the Glasgow list, and 110 and 93 are on the Dundee and Aberdeen lists respectively; in addition to these, 106 members reside in England and 49 reside abroad. Of the above, 250 are life-members.

The Council has to deplore the deaths of the Duke of Argyll and the Marquis of Lothian, Vice-Presidents and Past Presidents; of Sir John Cowan, Bart., Vice-President; of Sir Renny Watson, Chairman of the Glasgow Branch; of Major-General Sir Robert Murdoch Smith, K.C.M.G., Captain Hamilton Dunlop, R.N., Members of Council; and Mr. James Currie, Trustee; and of Dr. G. A. Turner, Member of Council and Hon. Secretary of the Glasgow Branch.

The Marquis of Lothian having acted as President of the Society for a period of five years, a Resolution was passed cordially thanking him for his services, and Sir John Murray, K.C.B., was appointed to succeed him as President.

DIPLOMAS OF FELLOWSHIP.

The Council conferred the Diploma of Fellowship (without fee) on Admiral Lord Charles Beresford, on Professor Carl Chun, and Captain Adalbert Krech of the *Valdivia*, on Captain Adrien de Gerlache, and Lieutenant Georges Lecointe

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ABSTRACT OF THE ACCOUNTS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

From 1st November 1899 to 31st October 1900.

FUNDS AT CLOSE OF LAST ACCOUNT:—			
£1000 Glasgow and South-Western Railway 4 per cent. Funded Debt, cost, 29th May 1885,		£1102	19 9
£533, 6s. 8d. North British Railway 3 per cent. Consolidated Lien Stock, cost, 30th December 1890,		496	2 0
£300 New Zealand Government 3½ per cent. Inscribed Stock, cost, 30th May 1894,		301	9 10
£200 Great Central Railway Company 4½ per cent. Debenture Stock, cost, 31st December 1898,		312	2 9
		£2212	14 4
BALANCES DUE BY BANK OF SCOTLAND:—			
On Current Account (Edinburgh),		103	4 6
Balance due by Secretary, £1, 15s. and by Honorary Treasurer, £42, 16s. 10d.,		44	11 10
		£2360	10 8
SUBSCRIPTIONS from Ordinary Members,	£1375 10 0		
Do. do. Life Members,	94 10 0		
FEES received for Society's Diploma,	3 3 0		
LECTURE TICKETS sold,	41 0 0		
MAGAZINES sold,	74 17 6		
DIVIDENDS and **INTERESTS**,	82 19 11		
	1672	0 5	
ANTARCTIC EXPLORATION FUND,	149	4 0	

MAGAZINE—Printing, Paper, Lithographing, etc., from Nos. 8 to 12 of Vol. XV., and Nos. 1 to 7 of Vol. XVI., all inclusive, and for Postages, Delivery, etc.,		£775	4 3
Less—Received during the year for Advertising,		60	0 0
		£715	4 3
GENERAL PRINTING,		29	14 9
BOOKS and other Furnishings for Library,		23	16 6
RENTS OF HALLS, and other expenses of Lectures,		246	19 4
RENT OF COUNCIL ROOM, Taxes, Gas, Repairs, Insurance, etc.,		125	2 0
SALARIES:—			
To *Secretary*,	£200 0 0		
,, *Editor and Clerks*,	228 3 4		
		428	3 4
MISCELLANEOUS, including Stationery, General Expenses, Advertising, Cleaning, Postages, and General Expenses at Glasgow Branch,		64	1 0
MEDALS,		10	10 0
FUNDS AT CLOSE OF THIS ACCOUNT:—			
£1000 Glasgow and South-Western Railway 4 per cent. Funded Debt, cost, 29th May 1885,	£1102 19 9		
£533, 6s. 8d. North British Railway 3 per cent. Consolidated Lien Stock, cost, 30th December 1890,	496 2 0		
£300 New Zealand Government 3½ per cent. Inscribed Stock, cost, 30th May 1894,	301 9 10		
£200 Great Central Railway Company 4½ per cent. Debenture Stock, cost, 31st December 1898,	312 2 9		
Balance due by Bank of Scotland, Edinburgh, on current account, £213 10 8			
Less—Applicable to Antarctic Exploration Fund, 49 4 0			
	164 6 8		
Cash in hands of Secretary, £5, 18s. 6d.; and Aberdeen Treasurer, £6, 5s. 2d.,	11 18 8		
	£2388	19 8	
ANTARCTIC EXPLORATION FUND:—			
Sum in Bank of Scotland, Edinburgh, on Deposit Receipt,	£100 0 0		
Sum in Bank of Scotland, Edinburgh, on current account as above,	49 4 0		
	149	4 0	

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of the *Belgica*, on Dr. Henry O. Forbes, and on Rev. Robert Laws, M.D. They also conferred the Ordinary Diploma of Fellowship on William Saltau Pillans, a member of the Society who had complied with the prescribed conditions.

Finance.

The Council submits the annexed Financial Statement, which shows that the Funds have been increased during the Session by £28, 9s.

Meetings.

The Society held 28 meetings, of which 13 were in Edinburgh, 6 in Glasgow, 5 in Dundee and 4 in Aberdeen. These meetings were addressed by Lord Charles Beresford, Rev. Dr. George Adam Smith, Rev. James Scott, Mr. H. O. Howarth, Mr. J. Young Simpson, Mr. J. B. Tyrrell, Mr. W. Barbrooke Grubb, Mr. W. R. Rickmers, Dr. Reginald Kœttlitz, Rev. Dr. Robert Laws, Mr. W. S. Bruce, Dr. Hugh Robert Mill, Mr. Nelson Annandale, Mr. Robert Smith, and Mr. Arthur H. Sharp.

The Society's Magazine.

The *Scottish Geographical Magazine* has, as usual, been published monthly throughout the past session.

Mr. W. A. Taylor, M.A., having resigned the office of editor, the Council desires to record its appreciation of his valuable services to the *Magazine* and the Society's Library. Mr. George Sandeman, M.A., was appointed to the duties of editor from 1st January.

The Council takes this opportunity of acknowledging its obligations to contributors of articles, and to the following gentlemen who have rendered valuable assistance to the editors:—N. Annandale, J. G. Bartholomew, R. W. K. Bain, F. Bosse, T. Craig-Brown, W. S. Bruce, Dr. James Burgess, C. G. Cash, Captain Hamilton Dunlop, Dr. Felkin, H. B. Finlay, Prof. Patrick Geddes, S. Heatley, Dr. Herbertson, Dr. Knott, Alexander Knox, D. MacRitchie, Ivison Macadam, Dr. M'Crindle, Rev. R. Mackenzie, R. C. Mossman, Dr. L. Oliphant, W. S. Pillans, J. R. Reid, Ralph Richardson, J. Young Simpson, Dr. George Smith, W. A. Taylor, H. A. Webster, and W. B. Wilson.

Library and Map Department.

During the past session, 295 books, 89 pamphlets and reports, 7 atlases and 574 map-sheets have been added to the Library; and six new exchanges have been arranged. The number of volumes borrowed by members was 1590. The Library is much resorted to by members and others who are in search of information. The expenses of the Library, including cost of binding, amounted to £23, 16s. 6d.

The Council desires to record its thanks to Foreign and Colonial Governments for the official publications presented to the Library, and also to private donors of books and maps, among whom may be mentioned:—Prof. Augustine Bernard, Mrs. Bishop, Dr. Robert N. Cust, Rev. Alexander Miller, Dr. Francisco P. Moreno, Michael G. Mulhall, Mrs. Bannatyne MacLeod, Governors of the John Rylands Library (Manchester), George Rattray, and Dr. J. Peddie Steele.

The Society's Rooms were closed during August for cleaning.

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Antarctic Expedition Fund.

The following additions to the fund have been received during the year, viz. :—

Miss Jane Hay,	£10	0	0
Mr. W. Beattie,	1	1	0
Mrs. Hay,	1	1	0
Mr. William Grieve,	2	2	0

The Council is ready to receive further subscriptions towards this important object, and trusts that a substantial proportion of the sum of £50,000 which is still required may be raised in Scotland.

The Society's Branches.

The Council has again the pleasure to acknowledge the services rendered by the Honorary Officials of the Branches of Glasgow, Dundee, and Aberdeen.

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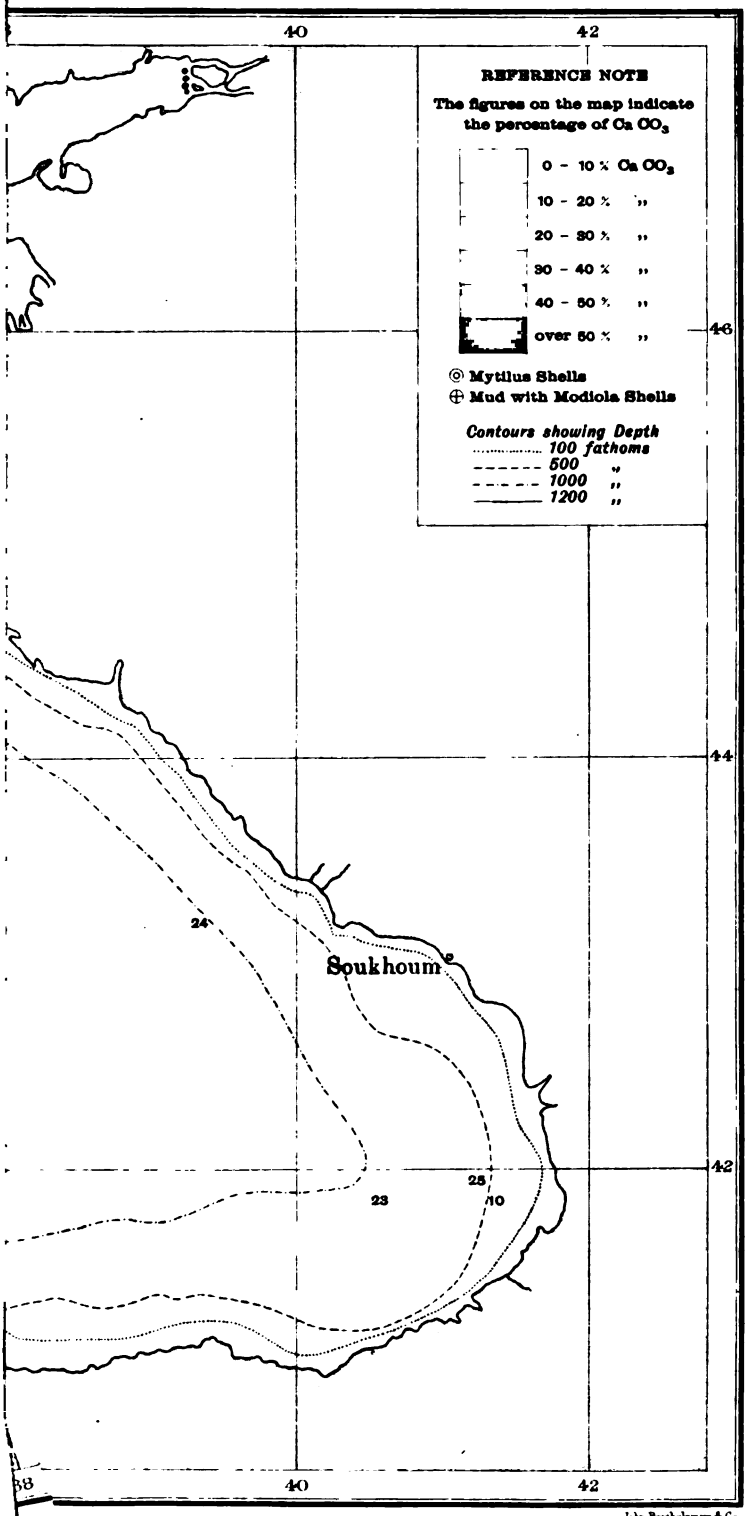

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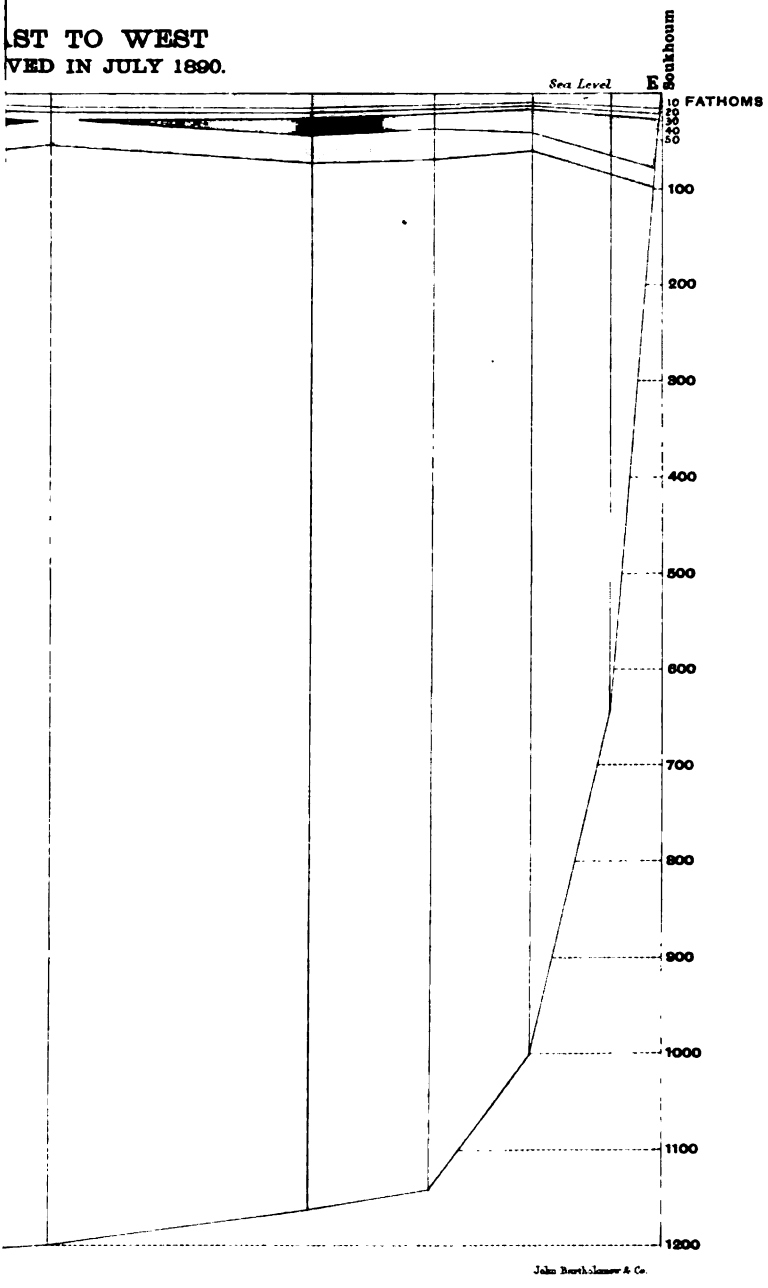

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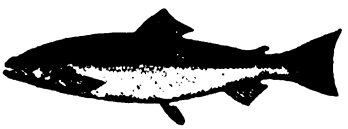

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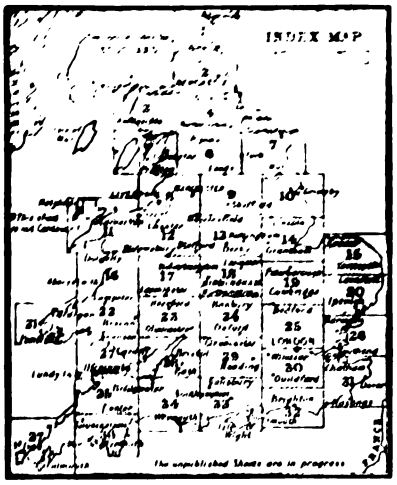

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